Senior Secondary Course

Computer Science (330)

330en

NIOS

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NIOS SENIOR SECONDARY - COMPUTER SCIENCE (330)

Complete Textbook (29 Lessons)

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COMPUTER FUNDAMENTALS

We find computers everywhere around us at home, in schools, hospitals, railway stations, airports, banks, and shopping malls and so on. Before we proceed with our study of computers, let us first of all define a computer.

A computer is an electronic machine that takes an input, processes it to produce the desired output. Every computer is a combination of hardware and software. The physical components of a computer that can be seen and touched form the hardware. For example, CPU, monitor, keyboard, printer etc., are hardware or peripheral devices. The input to a computer is given in the form of instructions. These set of instructions that we give to the computer to perform a particular task constitutes a program. Many such programs together form a software for the computer. Operating system, Antivirus, MS Office, Computer games are all software applications.

OBJECTIVES

After reading this lesson, you will be able to:

- learn the basic components of a computer along with their functions;
- differentiate input, output and storage devices;
- describe various memory accessing modes;
- explain different ports used to connect various components of a computer;
- classify computers.

1.1 WORKING OF A COMPUTER

To function properly, the computer needs both hardware and software. Hardware consists of the mechanical and electronic devices, which we can see and touch. The software consists of programs, the operating system and the data that reside in the memory and storage devices.

The working of a computer can be well understood by the block diagram shown in Fig. 1.1.

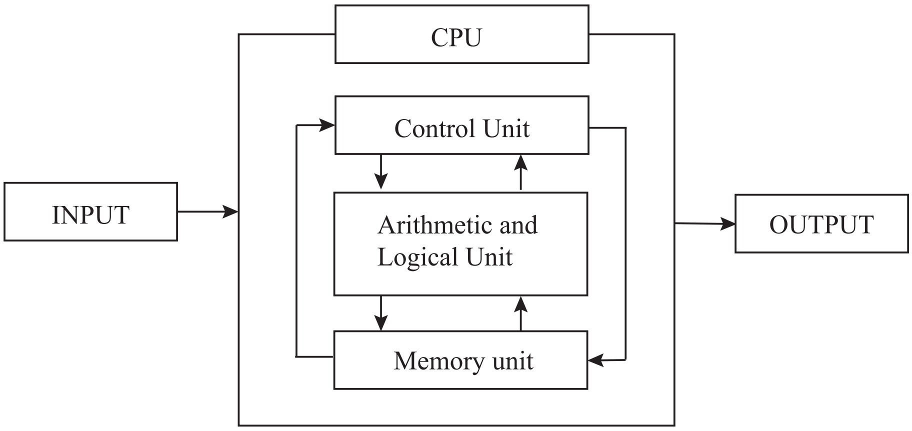

Fig. 1.1: Block diagram of a computer

The working of a computer can be broadly categorized into following four functions or steps.

(i) Receive input – Accept data/information from user through various input devices like the keyboard, mouse, scanner, etc.

(ii) Process information–Perform arithmetic or logical operations on data/ information.

(iii) Store information—Store the information in storage devices like hard disk, CD, pen drive etc.

(iv) Produce output–Communicate information to the user through any of the available output devices like monitor, printer, etc.

The hardware components of the computer specialize in any one of these functions. Computer hardware falls into two categories: processing hardware and the peripheral devices. The processing hardware consists of the Central Processing Unit (CPU), and as its name implies, it is where the data processing is done. Peripheral devices allow people to interact with the CPU. Together, they make it possible to use the computer for a variety of tasks.

Now we shall discuss in detail about various components of a computer system.

1.2 COMPONENTS OF A COMPUTER

Computer has four main components

- Input Devices : These are the devices that are used to accept data and instructions from the user. Keyboard, mouse, scanner etc., are the examples of input devices.

- Central Processing Unit (CPU) : This is known as the 'Brain of the Computer' as it controls the complete working of the computer.
- Memory: The data and instructions are stored in this component of the computer. Hard disk, DVD, pen drive etc., are the examples of memory storage devices.
- Output Devices: These are the devices that are used to display the desired result or information. Monitor, printer etc., are the examples of output devices.

Let us now learn each of the components in detail.

1.3 INPUT DEVICES

An input device is used to get data or instructions from the user. This data is then passed on to CPU for processing so as to produce the desired result. Although keyboard and mouse are the two common input devices, other devices such as Optical Character Recognition (OCR), Magnetic Ink Character Recognition (MICR), and mark sense reader, etc., are also used as per our requirement.

Keyboard

The keyboard is very much like a standard typewriter with a few additional keys. Generally, we find a QWERTY keyboard with 104 keys on it. The additional keys may be included in modern multimedia keyboards.

Fig. 1.2: Keyboard

Mouse

The mouse is another very commonly used input device. It is basically a pointing device that controls the movement of the cursor or pointer on a display screen. It is a small object that you can roll along a hard and flat surface. As you move the mouse, the pointer on the display screen moves in the same direction. A mouse may contain one, two or three buttons which have different functions depending on what program is running.

Mouse is an electro-mechanical device. It is also called as pointing device.

Fig. 1.3: Mouse

Scanner

Scanner is an input device that can read text or an illustration printed on paper and translates the information into a form that the computer can use. A scanner works by digitizing an image - dividing it into a grid of boxes and representing each box with either a zero or a one, depending on whether the box is filled in. The resulting matrix of bits, called a bit map, can then be stored in a file, displayed on a screen and manipulated by programs. Optical scanners do not distinguish text from illustrations; they represent all images as bit maps. Therefore, you cannot directly edit text that has been scanned. To edit text read by an optical scanner, you need an Optical Character Recognition (OCR) system to translate the image into ASCII characters.

Fig. 1.4: Scanner

Optical Character Recognition (OCR)

An Optical Character Recognition (OCR) is a device that is used for reading text from paper and translating the images into a form that the computer can understand. An OCR is used to convert books, magazines and other such printed information into digital form.

Magnetic Ink Character Recognition (MICR)

An MICR can identify characters printed with a special magnetic ink. This device particularly finds applications in banking industry. The cheques used for transactions have a unique MICR code that can be scanned by an MICR device.

Optical Mark Recognition (OMR)

Optical Mark Recognition, also called mark sense reader, is a technology where an OMR device senses the presence or absence of a mark, such as pencil mark. OMR is widely used for assessing the objective examinations involving multiple choice questions.

Bar Code Reader

A bar code reader is an input device that is generally seen in super markets, bookshops, libraries etc., A bar-code reader is a photoelectric scanner that reads the bar codes (vertical striped black and white marks), printed on product containers. The bar code reader scans the bar code of the product and checks the description and the latest price of the product.

Digitizing Tablet

This is an input device that enables you to enter drawings and sketches into a computer. A digitizing tablet consists of an electronic tablet and a cursor or pen. A cursor (also called a puck) is similar to a mouse, except that it has a window with cross hairs for pinpoint placement, and it can have as many as 16 buttons. A pen (also called a stylus) looks like a simple ballpoint pen but uses an electronic head instead of ink. The tablet contains electronic field that enables it to detect movement of the cursor or pen and translate the movements into digital signals that it sends to the computer. Digitizing tablets are also called digitizers, graphic tablets, touch tablets or simply tablets. Now-a-days most tablets allow you to simply use your finger to choose items or open or select apps by simply tapping them.

Light Pen

A light pen is an input device that utilizes a light-sensitive detector to select objects on a display screen.

Speech input devices

Speech or voice input devices convert a person's speech into digital form. These input devices, when combined with appropriate software, form voice recognition systems. These systems enable users to operate microcomputers using voice commands.

1.4 CENTRAL PROCESSING UNIT (CPU)

As mentioned earlier, CPU is the 'Brain of your computer'. This is because it processes or executes the instructions given to the computer. Any type of instruction given to the computer using any of the input devices has to be sent to the CPU for execution. In a microcomputer, the CPU is based on a single chip called the microprocessor.

A typical CPU has the following components:

- Control Unit (CU)
- Arithmetic Logic Unit (ALU)
- Memory Registers

1.4.1 Control Unit (CU)

The Control unit manages the instructions given to the computer. It coordinates the activities of all the other units in the system by instructing rest of the components of the computer about how to carry out a program's instructions. It reads and interprets instructions from memory and transforms them in to series of signals to be executed or stored. It also directs the movement of these electronic signals between memory and ALU or between CPU and input/output devices. Hence it controls the transfer of data and information between various units. The user's program provides the basic control instructions. Conceptually, the control unit fetches instructions from the memory, decodes them and directs the various units to perform the specified functions.

1.4.2 Arithmetic Logic Unit (ALU)

Arithmetic Logic Unit or ALU performs two types of operations - arithmetic and logical. Arithmetic operations are the fundamental mathematical operations consisting of addition, subtraction, multiplication and shifting operations. Logical operations consist of boolean comparisons such as AND, OR and NOT.

1.4.3 Memory Registers

The CPU processes data and instruction with high speed. There is also movement of data between various units of the computer. It is necessary to transfer the processed data with high speed. So the computer uses a number of special memory units called registers. A memory register is a sort of special storage area that holds the data and instructions temporarily during processing. Since this is internally located in the CPU, the processing time is very less. They often hold data for less than a millisecond. This high speed storage area make processing more efficient.

To locate the characters of data or instructions in the main memory, the computer stores them in locations known as addresses. A unique number designates each address. Addresses can be compared to post office mailboxes. Their numbers remain the same, but contents continuously change.

The contents of the memory are held only temporarily, that is, it is stored only as long as the microcomputer is turned on. When you turn the machine off, the contents are lost. The capacity of the memory to hold data and program instructions varies in different computers. The original IBM PC could hold approximately several thousand characters of data or instructions only. But modern microcomputers can hold millions or even billions of characters in their memory.

How the CPU and Memory work together?

The working of the CPU and memory is shown in Fig. 1.5.

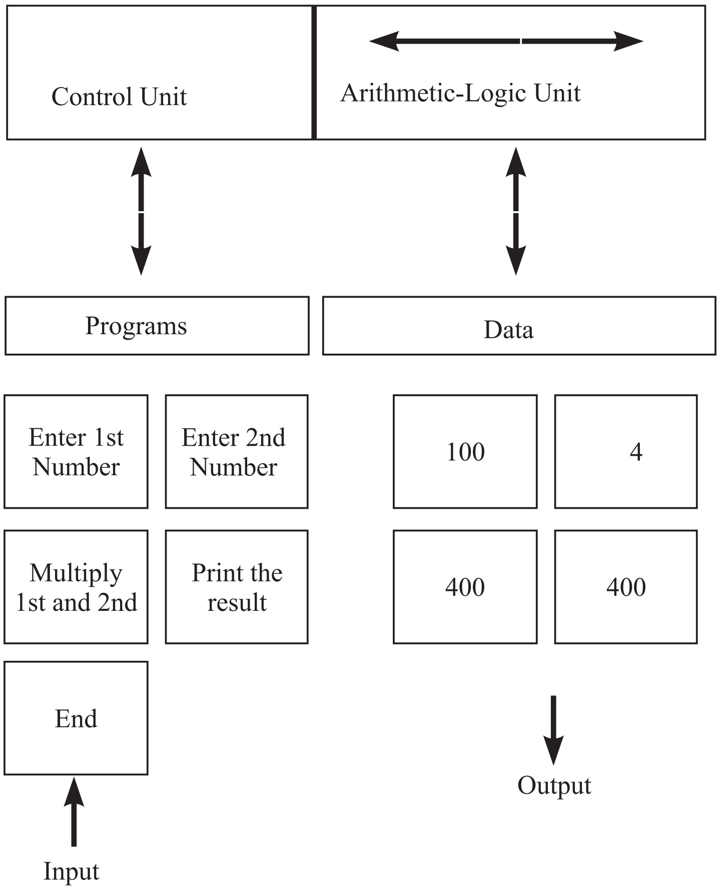

Fig. 1.5: Working of the CPU and Memory

Various steps involved for multiplying two numbers is shown in Fig. 1.5. Let us take an example and understand how CPU and memory work together to execute a given instruction. The control unit recognizes that the program has been loaded into the memory. It begins to execute the first step in the program.

1. The program tells the user, "Enter 1st Number".
2. The user types the number 100 on the keyboard. An electronic signal is sent to the CPU.
3. The control unit recognizes this signal and routes the signal to an address in memory - say address 7.
4. After completing the above instruction, the next instruction tells the user, "Enter 2nd Number."
5. The user types the number 4 on the keyboard. An electronic signal is sent to the CPU.

6. The control unit recognizes this signal and routes it to memory address 8.
7. The next program instruction is executed - “Multiply 1st and 2nd Numbers”.
8. To execute this instruction, the control unit informs the ALU that two numbers are coming and the ALU has to multiply them. The control unit next sends to the ALU a copy of the contents of address 7 (100) and address 8(4).
9. ALU performs the multiplication: $100 \times 4 = 400$
10. The control unit sends a copy of the multiplied result (400:) back to memory to store it in address 9.
11. The next program instruction is executed: “Print the Result.”
12. To execute this instruction, the control unit sends the contents of the address 9 (400) to the monitor.
13. Monitor displays the value 400.
14. Final instruction is executed: “End”. The program is end.

Please note that Fig. 1.5 is a simplified version of the actual processing activity. The actual working of the CPU and memory is much more complicated. For example, there are actually many more memory addresses - thousands to millions that cannot be shown here. Moreover, the addresses are in a form that the computer can interpret. The data and instructions are stored in the computer in the form of 0s and 1s only.

1.5 OUTPUT DEVICES

Output devices receive information from the CPU and present it to the user in the desired form. Some of the output devices are monitor, printers, plotters, etc. Let us now learn each of them in detail.

1.5.1 Monitor

The monitor is just like a television screen and it is used to display data and information. When some data or instruction is being keyed in, the monitor displays the characters being typed. The monitors are available in various sizes. They may also differ for different types of computers. The standard size is 24 lines by 80 characters. The output displayed on the monitor is called soft copy.

Monitor is also called as Visual Display Unit

There are two types of monitors – CRT and TFT-LCD monitors.

CRT Monitor : CRT (Cathode Ray Tube) monitor is a relatively older type of monitor. It is rarely being used today. These were bigger and bulkier monitors and hence took lot of desk space. They also consumed lot of electricity.

TFT-LCD monitors: TFT stands for Thin Film Transistor and LCD stands for Liquid Crystal Display. These monitors are lighter and occupy less space. They are also commonly referred to as flat screen displays and consume much less electricity than CRT monitors. Now-a-days even LED (Light Emitting Diode) monitors are being used.

Fig. 1.6: monitor

1.5.2 Printer

You must have used printer for taking printouts. Printer is a device that produces the output on paper. Such an output is also known as hard copy and it may be in the form of text or graphics. There are many different types of printers. These printers vary in terms of size, speed and quality of output. Some of them are discussed below:

(i) **Dot Matrix Printer :** It is a type of printer that uses a print head to print characters on paper. The print head moves in back and forth or up and down motion on the page. The print head strikes on an ink soaked cloth ribbon that is laid against a paper. The characters formed from dots are thus printed on the paper.

(ii) **Ink-jet Printer:** Ink-jet printers work by spraying ionized ink on a sheet of paper. Magnetized plates in the ink's path direct the ink onto the paper in the desired shapes. Ink-jet printers are capable of producing a better print than the dot matrix printers. A typical ink-jet printer provides a resolution of 300 dots per inch, although some newer models offer higher resolutions. These are also known as **Line printers** as the output is produced line by line.

In general, the price of ink-jet printers is lower than that of laser printers. However, they are also considerably slower. Another drawback of ink-jet printers is that they require a special type of ink that is apt to smudge on inexpensive

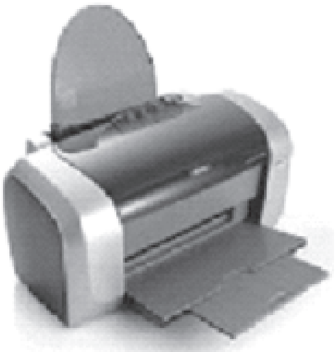

Fig. 1.7: Ink-jet printer

copier paper. Since ink-jet printers require smaller mechanical parts than laser printers, they are especially popular as portable printers. In addition, colour ink-jet printers provide an inexpensive way to print full-colour documents.

(iii) **Laser Printer:** It works on the principle of a photocopier. It utilizes a laser beam to produce an image on a drum. The light of the laser alters the electrical charge on the drum wherever it hits. The drum is then rolled through a reservoir of toner, which is picked up by the charged portions of the drum. Finally, the toner is transferred to the paper through a combination of heat and pressure.

Since the entire page is transmitted to a drum before the toner is applied, laser printers are sometimes called page printers. In addition to text, laser printers are very adept at printing graphics. However, you need significant amounts of memory in the printer to print high-resolution graphics.

The speed of laser printers ranges from about 4 to 20 pages of text per minute (ppm). A typical rate of 6 ppm is equivalent to about 40 characters per second (cps).

(iv) **Thermal printer:** Thermal printers are printers that produce images by pushing electrically heated pins against special heat-sensitive paper. Thermal printers are inexpensive and are used in most calculators and many fax machines. They produce low-quality print, and the paper tends to curl and fade after a few weeks or months.

1.5.3 Plotter

A Plotter is a device that is used to draw charts, graphs, maps etc., with two or more automated pens. Multi-colour plotters use different-coloured pens to produce a multi-coloured output.

Fig. 1.8: Plotter

Different types of plotters are available in the market. A drum plotter has a paper wrapped around a moving drum and the pens move on the paper to print the output. A flatbed plotter has a flat surface on which the paper is placed and the pens move to draw the output. An electrostatic plotter has a negatively charged paper on which the drawing is made using a positively charged toner.

Plotters are considerably more expensive than printers. These were the first of the devices that could print full sized engineering drawings with colour. They are frequently used for Computer Aided Engineering (CAE) applications such as Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM).

1.5.4 Speakers

The speakers are used to produce audio output. The computers have sound cards that enable the computer to produce audio output through the speakers.

Fig. 1.9: Sound Card and Speakers

Now-a-days, 3D audio is a technique for giving more depth to traditional stereo sound. Typically 3D sound or 3D audio is produced by placing a device in a room with stereo speakers. The device dynamically analyses the sound coming from the speakers and sends feedback to the sound system so that it can read just the sound to give the impression that the speakers are further apart. 3D audio devices are particularly popular for improving computer audio where the speakers tend to be small and close together. There are a number of 3D audio devices that can be attached to a computer's sound card.

INTEXT QUESTIONS 1.1

Fill in the blanks:

1. The four basic functions performed by the computer are ...., ..., ..., ...
2. A bar code reader is a / an .... device.

Notes

3. Choose the correct answer:

(a) Arithmetic and logical operations is performed by .... unit.

(i) ALU (ii) Editor (iii) storage (iv) output

(b) The ALU and CU are jointly known as ....

(i) RAM (ii) ROM (iii) CPU (iv) none of the above

(c) The process of producing results from the data for getting useful information is called as ....

(i) output (ii) input (iii) processing (iv) storage

1.6 MEMORY UNIT

There are two kinds of computer memory: primary and secondary. Primary memory is accessible directly by the Central Processing Unit. RAM is an example of primary memory. You will know more about RAM later in this lesson. As soon as the computer is switched off, the primary memory loses its contents. But data can be stored and retrieved at much faster rate with primary memory as compared to secondary memory. Examples of secondary memory storage devices are floppy disk, magnetic disk, hard disk, CD, pen drive etc. The secondary memory devices may be inside or located outside the computer. Primary memory is more expensive than secondary memory.

When the computer is doing any task, the data that have to be processed are stored in the primary memory. This data may come from an input device like keyboard or from a secondary storage device like a hard disk. As program or the set of instructions is kept in primary memory, the computer is able to follow them instantly. For example, when you book ticket from railway reservation counter, the computer has to follow some steps, viz., take the request, check the availability of seats, calculate fare, wait for money to be paid, save the reservation and print the ticket. The program containing these steps is kept in primary memory of the computer.

But inside the computer, the steps followed are quite different from what we see on the monitor or screen. In computer's memory both programs and data are stored in the binary form. You have already been introduced with decimal number system that is the numbers 0 to 9. The binary system has only two digits, 0 and 1. These are called bits. A bit is an acronym for binary digit, which stands for one binary piece of information. As human beings we all understand decimal system but the computer can only understand binary system. Consider that a computer consists of numerous switches. If a switch is ON then it is considered as 1 otherwise it is considered as 0. A number of switches in different states will give you a message like this: 110101......10. So the computer takes input in the form of 0 and 1 and gives output in the same form, i.e., 0 and 1 only. But we do not receive

output in the form of 0's & 1's only. This is because every number stored in binary form can be converted to decimal system and vice versa. For example, 1010 in binary is equivalent to 10 in decimal. Therefore, it is the computer that takes information or data in decimal form from you, converts it into binary form, processes it, produces output in binary form and finally again converts the output to decimal form.

Measuring Memory

The primary or internal storage unit is made up of several small storage locations called cells. Each of these cells can store a fixed number of bits called word length. Each cell has a unique number assigned to it called the address of the cell and it is used to identify the cells. Hence we can say that memory is like a large cabinet containing as many drawers as there are addresses on memory. Each drawer contains a word and the address is written on outside of the drawer.

You know that data in computer is stored in the form of 0s and 1s. Each of these digits is known as a bit. A collection of 8 bits constitutes a byte. Each cell of memory contains one character or 1 byte of data. So the capacity is defined in terms of bytes or words. However higher units of memory are Kilobytes, Megabytes, Gigabytes etc. 1 Kilobyte is equal to 1024 bytes. Thus 64 Kilobyte (KB) memory is capable of storing 64 × 1024 = 32,768 bytes. Other units of memory are listed in the table below:

(KB) Kilobyte	2^{10} = 1024 bytes
(MB) Megabyte	2^{20} = 1024 KB
(GB) Gigabyte	2^{30} = 1024 MB
(TB) Terabyte	2^{40} = 1024 GB

1.6.1 Primary Memory

Primary memory is the memory that is accessed by the processor directly. It is also known as main memory or internal memory. It helps in executing applications that are temporarily stored in a specific memory location. Primary memory is of two types – RAM and ROM.

Random Access Memory (RAM)

Random Access Memory (RAM) is the type of memory in which it is possible to randomly select and use any location of the memory directly to store and retrieve data. It is also called as read/write memory. Since it is volatile, the data from RAM is lost as soon as the power to the computer is switched off.

Read Only Memory (ROM)

This is another type of primary memory from which data can only be read. We cannot write or modify data once written on to the ROM. Also this type of primary memory is not volatile. The storage of program and data in the ROM is permanent. The ROM stores some standard processing programs supplied by the manufacturers to operate our computer. The Basic Input Output System (BIOS) is stored in the ROM. It examines and initializes the start up process of the computer and also checks various peripheral devices attached to the PC when the computer is turned ON. The various types of ROMs are discussed below:

- **Programmable Read Only Memory (PROM)**: You know that it is not possible to modify or erase programs stored in ROM, but it is possible for you to store your program in PROM chip. Once the programs are written it cannot be changed. Also the program is not lost even if power is switched off.

- **Erasable Programmable Read Only Memory (EPROM)** : This type of ROM overcomes the problem of PROM and ROM. EPROM chip can be programmed time and again by erasing the information stored earlier in it. Information stored in EPROM can be erased by exposing it to ultraviolet light. This memory can be reprogrammed using a special programming facility. When the EPROM is in use, information can only be read.

- **Electrically Erasable Programmable Read Only Memory (EEPROM)**:This type of ROM is somewhat similar to EPROM. The only difference is that unlike EPROM, electrical signals are used to erase the contents of EEPROM. Also, this type of ROM need not be completely erased. Partial modification of ROM is possible.

1.6.2 Cache Memory

The speed of CPU is extremely high as compared to the access time of main memory. Therefore, the performance of CPU decreases due to the slow speed of main memory. To increase the performance of CPU, a small memory chip is attached between CPU and main memory whose access time is very close to the processing speed of CPU. This memory is called as Cache memory. Cache memories are accessed much faster than conventional RAM. It is used to store programs or data currently being executed or data that is being frequently used by the CPU. Fast access of these data and instructions increases the overall execution speed of the software. It is very expensive memory and so has to be used in a limited amount.

Cache memory is also known as CPU memory. It is either integrated directly with the CPU chip or is placed separately on the motherboard. As the microprocessor processes data, it first looks in the cache memory. If the required data or instructions are found there, it does not have to spend more time in reading data

from other storage devices that have slower access time. Hence the processing speed increases.

1.6.3 Secondary Memory

You are now clear that the operating speed of primary memory or main memory should be as fast as possible so as to cope up with the CPU speed. These high-speed storage devices are very expensive and hence the cost per bit of storage is also very high. Again, the storage capacity of the main memory is also very limited. Often it is necessary to store hundreds of millions of bytes of data for the CPU to process. Therefore, additional memory is required in all the computer systems. This memory is called auxiliary memory or secondary storage.

In this type of memory the cost per bit of storage is low. However, the operating speed is slower than that of the primary memory. Huge volume of data are stored here on permanent basis and transferred to the primary storage as and when required. Most widely used secondary storage devices are hard disks, CDs, DVDs and pen drives. But before learning about these modern storage devices let us also have a look at some primitive storage devices like magnetic tapes, magnetic drums and floppy disks.

Magnetic Tape

Magnetic tapes are used for large computers like mainframe computers where large volume of data is stored for a longer time. Earlier these were used with PCs also. The cost of storing data in tapes is inexpensive. Tapes consist of magnetic materials that store data permanently. It can be 12.5 mm to 25 mm wide plastic film-type and 500 meter to 1200 meter long which is coated with magnetic material. The deck is connected to the central processor and information is fed into or read from the tape through the processor. It is similar to a cassette tape recorder.

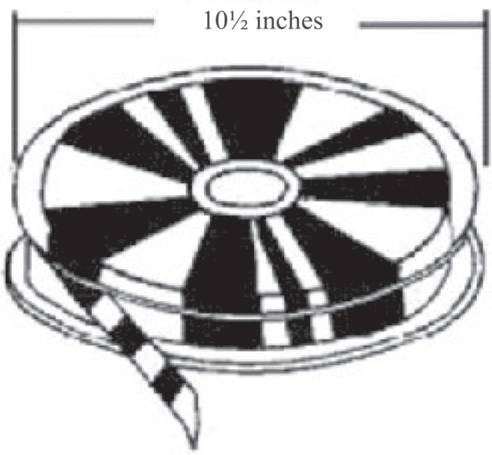

Fig. 1.10: Magnetic Tape

Magnetic Disk

You might have seen the gramophone record, which is circular like a disk and coated with magnetic material. Magnetic disks used in computer are also made on the same principle. It rotates with very high speed inside the disk drive. Data are stored on both the surfaces of the disk. Magnetic disks are most popular for direct access storage. Each disk consists of a number of invisible concentric circles called tracks. Information is recorded on tracks of a disk surface in the form of tiny magnetic spots. The presence of a magnetic spot represents one bit (1) and its absence represents zero bit (0). The information stored in a disk can be read many times without affecting the stored data. So the reading operation is non-destructive. But if you want to write a new data, then the existing data is erased from the disk and new data is recorded.

Floppy Disk

It is similar to magnetic disk discussed above. It is 3.5 inch in diameter. The capacity of a 3.5 inch floppy is 1.44 mega bytes. It is cheaper than any other storage devices and is portable. The floppy is a low cost device particularly suitable for personal computer system.

Floppy disks have been made obsolete because the storage space was very small in floppy disks in comparison to other storage devices.

Fig. 1.11: Floppy Diskette

Hard Disk

A hard disk is the most commonly used secondary storage device. Although generally it is fixed inside the CPU cabinet but still external hard disks are also available. It can store huge amount of data and also and provides relatively quick access to data stored on it.

A hard disk is a set of numerous disks stacked one above the other with a cylindrical spindle in-between (Fig. 1.12). The data is recorded electromagnetically in the form of concentric circles called tracks. The tracks are further divided into blocks as shown in the figure. In the hard disk drive, there is a Read/Write head mounted on the arm placed next to the stacked disks. This head moves horizontally and vertically to read or write data on the disks.

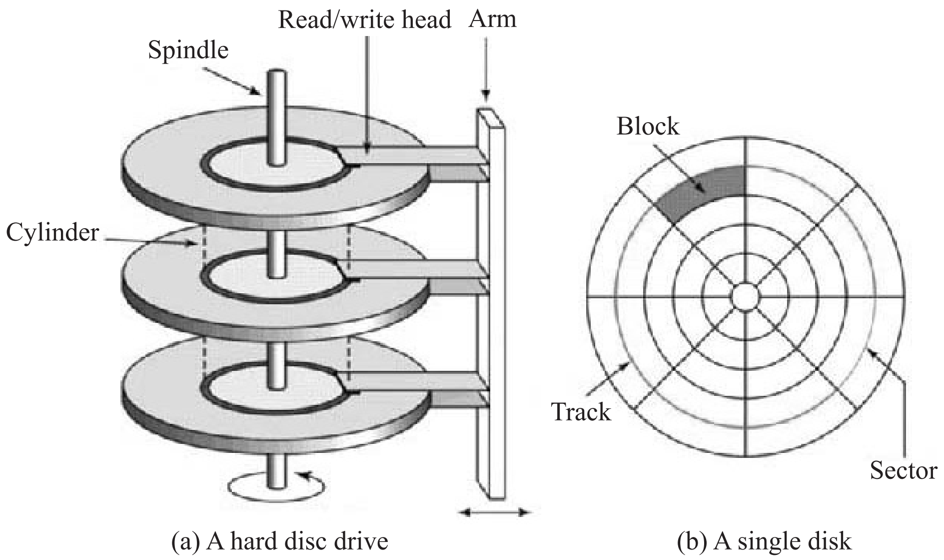

Fig. 1.12: Hard disk

Optical Disk

With every application and software there is greater demand for memory capacity. It is the necessity to store large volume of data that has led to the development of optical disk storage medium. Optical disks can be divided into the following categories.

- **Compact Disk - Read Only Memory (CD-ROM):** CD-ROMs are made of reflective metals. A CD-ROM is written during the process of manufacturing by high power laser beam. Here the storage density is very high, storage cost is very low and access time is relatively fast. Each disk is approximately 4 ½ inches in diameter and can hold over 600 MB of data. As the CD-ROM can be read only we cannot write or make changes into the data contained in it.

- **Compact Disk** - Recordable (CD-R) : These CDs can be used to write data on to them provided your computer has a CD writer. The CD writer uses a special laser light to write data on to a blank CD. Once the CD-R has been burnt, i.e. data has been written on it, it cannot be modified. The information can be added to it but the parts that have been burnt cannot be edited.

- **Compact Disk** – Read/Write (CD- R/W): This type of CD can be used for both reading and writing. Also these can be written and erased again and again.

- **Digital Versatile Disk (DVD) :** A DVD is an optical storage disk with much larger storage capacity than that of CDs. A single sided DVD can store upto 4.7 GB of data. Due to its high storage capacity, DVDs are generally used to store movies and other audio video files.

Flash Memories

Flash memory is a memory chip that is used for storage and also for transferring of data between a computer and digital device. A flash memory is one that retains data in spite of the electricity supply being switched off. Hence it is a non- volatile memory. It evolved from EPROM and EEPROM but more often it is said to be a distinct type of EEPROM which is programmed and erased in blocks. That means devices using flash memories erase data at the block level. A block of flash memory chip must be erased before data is written on it.

Flash memory is widely used for storage in consumer devices like mobile phones, USB flash drives, tablet computers, digital cameras and other solid state drives. It is the least expensive form of semiconductor memory. It is non-volatile and consumes very less power. That is why its use is increasing day by day, especially for in-memory devices to help speed up performance and at the same time increase the scalability of the devices. The data in flash memory can be erased, modified and rewritten many times. It does not require batteries for solid state storage. It has very fast access time and also has higher resistance to kinetic shock as compared to hard disk drive. It is extremely durable and can withstand extreme pressure and temperature.

The **memory card** that you find in your digital cameras and mobile phones is also a type of flash memory. A variety of such cards are available in the market. Some of the varieties are Secure Digital Card (SD Card), Memory stick, Multimedia Card (MMC) etc. The price of these cards depends on their size and their storage capacities.

Another form of flash memory or solid state memory is a **pen drive**. A pen drive is a small portable secondary storage device (somewhat shaped like a pen) that connects to a computer through a USB port. It functions as a portable hard drive and is small enough to be carried easily. These are also known as thumb drives.

INTEXT QUESTIONS 1.2

1. Fill in the blanks.

   (a) 1 KB = ... bytes.

   (b) Primary memory is of two types : .... and ....

   (c) To increase the performance of CPU, a small memory chip is attached between CPU and main memory whose access time is very close to the processing speed of CPU. This memory is called .... memory.

   (d) A hard disk is the most commonly used .... storage device.

2. State whether the following statements are true or flase:
   (a) There are two kinds of computer memory: primary and secondary.
   (b) The computer can understand decimal system also.
   (c) The storage of program and data in the RAM is permanent.
   (d) PROM is secondary memory.
   (e) The memories which do not lose their content on failure of power supply are known as non-volatile memories.

1.7 MEMORY ACCESSING MODES

An addressing mode refers to the manner in which a given memory location is accessed. Some of the memory accessing modes are discussed below:

1.7.1 Direct Access or Random Access

It is the type of accessing mode in which the value to be stored in a particular memory location is obtained directly. Since the data can be accessed in any order that is why this type of memory access is also known as random access of memory. This type of memory access is generally fast and more flexible. The type to be stored in memory is obtained directly by retrieving it from another memory location. This type of memory access is based on the principle that any piece of data can be returned in a constant time, regardless of its physical location and previous access. The web uses direct memory access mode.

1.7.2 Sequential Access memory

It is the type of memory in which the stored data is read in sequence. That means if you want to display the fourth record, the reading will start from the first record and then move to second, third and then fourth record. This type of memory access can be time consuming and hence slow, especially when the data to be read is towards the end. Sequential access devices are generally a form of magnetic storage. Hard disks, CD-ROMs and magnetic tapes use sequential access of memory.

The Fig 1.13 illustrates the concept of random and sequential memory access.

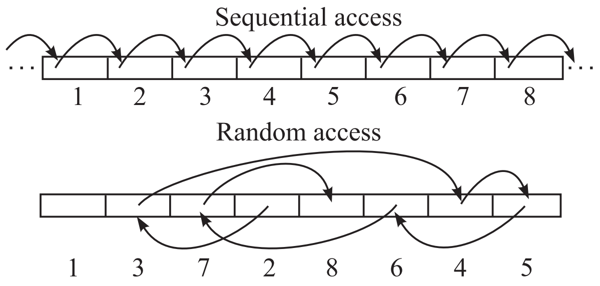

Fig. 1.13: Sequential and Random Memory Access

Notes

1.8 SYSTEM SECURITY AND DATA SECURITY

Securing your computer and also the data stored on your computer is the worldwide concern today. Securing stored data involves preventing unauthorized people from accessing it. It also includes preventing accidental or even intentional destruction or modification of data. Hence data security involves digital privacy measures that are applied to prevent any sort of unauthorized access to computers, databases or even websites.

There are various data security measures that are prevalent nowadays. These include software/hardware disk encryption, backups, data masking, scrambling etc.

1.9 PORTS

Ports are the connecting points on the CPU. Monitor, keyboard, printer and other peripheral devices are connected to the computer through ports. Some of the ports are discussed below:

Serial Ports

A serial port transfers data one bit at a time. It is a single wire that transmits 8 bits of data. Also a start byte has to be transmitted before each byte of data and a stop bit has to be sent after the byte. Serial ports are also known as COM ports or RS232C ports and come in the form of 9 pin or 25 pin male connector. A mouse is connected to the CPU through a serial port.

Parallel Port

A parallel port sends or receives 8 bits (1 byte) at a time. These 8 bits are transmitted in parallel to each other. These ports come in the form of 25-pin female connector and are generally used to connect devices like printer, scanner, external hard disk drive etc.

USB Port

USB stands for Universal Serial Bus. It is becoming popular day by day and is used to connect variety of devices like printers, scanners, mouse, keyboard, speakers etc. It is a simple and an easy to use port.

InfraRed Port

This port sends and receives a ray of light of infrared frequency from one device to another. These types of ports are used for wireless data transmission. This is the same technology that is used for TV remotes and in case of computers, it is used in devices like wireless keyboard and wireless mouse.

Bluetooth

A Bluetooth is a telecommunication industry specification that is used to connect mobile phones, computers and other such devices to connect to each other using short range wireless connection. The maximum range of Bluetooth communication is 10 meters.

1.10 CLASSIFICATION OF COMPUTERS

The computers can be classified according to their shapes and sizes and also according to the technology being used. Do you know the different types of computers available in the market today?

Broadly, computers can be of three types:

- **Analog Computers:** These computers work with continuous and physical quantities like temperature, voltage, current, weight etc. These are not as accurate as digital computers. They are used in engineering and scientific applications. For example, a blood pressure monitoring machine is a type of analog computer.
- **Digital Computers:** These computers work with discrete quantities. The data is converted into binary form i.e., 0s and 1s.These are much faster than the analog computers and are also far more accurate. We use digital computers for scientific and business applications. Digitally programmed watches are good examples of digital computers.
- **Hybrid Computers:** These types of computers use both analog and digital technology. Some calculations may take place in analog manner while others may be in digital form. These are used in weather forecasting.

1.10.1 Types of Digital Computers

Digital computers can be further classified as follows:

(i) MicroComputers

A microcomputer is a computer that contains a microprocessor chip inside it. These are mainly used in offices, homes, schools, shops etc. These microcomputers can be further categorized as :

a. *Mobile Computers:* These computers can be held in hand and used for variety of purposes. Although they have limited capabilities as compared to other micro- computers, yet they are being used extensively, these days because of excellent features contained in them. An excellent example of this type of microcomputer is a smartphone. In addition to communicating with people, a smartphone has an internet connection

so that we use various web services like email, chat, video chat, GPS, online games etc. Smartphones generally have a touch screen interface.

b. *Portable Personal Computers:* This category of microcomputers includes laptops, notebooks, tablets etc. These are larger in size than mobile computers but can be easily carried from one place to another.

c. *Desktop PCs:* These computers are installed on a table or desk. These are large and heavy computers. So they are not portable. These are generally used in places where the user has to work sitting at one place only like offices, shops, hospitals, ticket booking counters etc.

(ii) Minicomputers

Minicomputers provide faster operating speeds and larger storage capacity than microcomputers. These serve as servers in multiuser environments. These computer can support large number of high speed input/output devices and also many users can simultaneously work on these systems. Small business organizations having about 50-100 users use minicomputers as their servers.

(iii) Mainframe Computers

Mainframe computers or simply mainframes are the second largest in terms of the capacity and size of computers. Mainframes are huge and very expensive computers but can support hundreds of users at a time. These multi-processor systems have very large storage capacity and so can handle huge volumes of data and information. These are used in large organizations like railways where centralized data for the entire railway reservation system is maintained.

(iv) Supercomputers

Supercomputers are the most powerful computers in the world. In a supercomputer many processors work simultaneously, so they have very high processing speed. They can process huge volume data and information with ultrafast calculations. Supercomputers are used in specialized applications like weather forecast, space research, molecular modeling etc.

INTEXT QUESTIONS 1.3

Fill in the blanks:

1. USB stands for ....
2. The maximum range of bluetooth communication is .... meters.
3. Digital computers can be classified as ...., ..., ... and ....

WHAT YOU HAVE LEARNT

- Computer is an electronic machine that takes an input, processes it to produce the desired output.
- Hardware consists of the mechanical and electronic devices, which we can see and touch.
- The software consists of programs, the operating system and the data that reside in the memory and storage devices.
- Computer has four main components namely input devices, output devices, memory, CPU.
- An input device is used to get data or instructions from the user.
- Central Processing Unit is the brain of computer.
- Output devices receive information from the CPU and present it to the user in the desired form.
- There are two kinds of computer memory: primary and secondary.
- Direct access memory is the type of accessing mode in which the value to be stored in a particular memory location is obtained directly.
- Sequential access memory is the type of memory in which the stored data is read in sequence.

TERMINAL EXERCISE

1. What are the major components of a computer?
2. What is CPU and how does it work? Explain briefly.
3. What is a plotter and how does it work?
4. Describe the various types of printers briefly.
5. Differentiate between the following:
   (a) RAM and ROM
   (b) Volatile and non-volatile memory.
   (c) Sequential access and Random access
6. Explain different types of ports.

ANSWERS TO INTEXT QUESTIONS

1.1

1. receive input
   process information
   produce output
   store information for future use
2. input
3. (a) ALU (b) CPU (c) processing

1.2

1. (a) 1024
   (b) RAM, ROM
   (c) cache
   (d) secondary
2. (a) True (b) False (c) False
   (d) False (e) True

1.3

1. Universal Serial Bus
2. 10
3. Microcomputers, minicomputers, mainframe computers, supercomputers.

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2

BINARY LOGIC

In the previous lesson, you have learnt about computer fundamentals. In this lesson you will learn about binary logic. In digital computers, everything (including letters, words and whole texts) is represented in binary numbers (zero and one) i.e., it stores data in terms of bits. Binary logic is the basis of electronic systems, such as computers and cell phones. It works on 0's and 1's. It involves addition, subtraction, multiplication, division of zeros and ones. It includes logic gate functions, AND, OR and NOT which translates input signals into specific output. It facilitates computing, robotics and other electronic applications. In this lesson you will learn about binary numbers, octal numbers, hexadecimal numbers, conversion from one number system to another, character coding system and logic gates.

OBJECTIVES

After reading this lesson, you will be able to:

- define binary numbers, octal numbers and hexadecimal numbers;
- convert from one number system to another;
- use character coding system;
- identify logic gates.

2.1 NUMBER SYSTEM

You know that computer stores and processes two basic types of data viz.,character and number. The character type data includes alphabets and some special symbols, while the number data type includes numerical data on which arithmetic calculations can be done. For example, student name contains character data, roll number will have numeric data.

Digital computers internally use the binary (base 2) number system to represent data and perform arithmetic calculations. The binary number system is very

efficient for computers, but not for humans. Representing even relatively small numbers with the binary system requires working with long strings of ones and zeroes.

2.1.1 Binary numbers

Binary numbers are combination of two basic numbers (zero and one) while decimal numbers are combinations of 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.All the numbers which are generated by decimal numbers can also be generated by Binary numbers. Binary number has base 2 because all numbers are generated by combination of only two numbers (0 and 1) and decimal number has base 10 because all numbers are generated by combination of only ten numbers (0 to 9).

2.1.2 Octal Number and Hexadecimal numbers

Octal (base 8) was previously a popular choice for representing digital circuit numbers in a form that is more compact than binary. Octal is sometimes abbreviated as oct.

Octal counting starts at 0 and goes: 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13 14 15 and so on.

Hexadecimal (base 16) is currently the most popular choice for representing digital circuit numbers in a form that is more compact than binary. Hexadecimal numbers are sometimes represented by preceding the value with ‘0x’, as in 0x1B84. Hexadecimal is sometimes abbreviated as hex.

Hexadecimal counting goes: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F, 10, 11, and so on.

The following table shows the decimal number 0 to 15 and its corresponding binary, octal and hexadecimal values.

Decimal, Binary, Octal and Hexadecimal values

Decimal	Binary	Octal	Hexadecimal
0	0000	000	0
1	0001	001	1
2	0010	002	2
3	0011	003	3
4	0100	004	4
5	0101	005	5

6	0110	006	6
7	0111	007	7
8	1000	010	8
9	1001	011	9
10	1010	012	A
11	1011	013	B
12	1100	014	C
13	1101	015	D
14	1110	016	E
15	1111	017	F

All four number systems are equally capable of representing any number. Furthermore, a number can be perfectly converted between the various number systems without any loss of numeric value.

2.1.3 Conversion from one system to another

1. Decimal to Binary Conversion

There are two methods you can use: successive division and subtracting values using a table. Successive division requires dividing continuously by the base we are converting to until the quotient equals 0. The remainders compose the answer.

Steps for conversion from Decimal to Binary

1. Divide the decimal number by 2.
2. Take the remainder and record it on the side.
3. Repeat until the decimal number can not be divided into any more.
4. With the bits, record them in order from right to left as that will be the number in base 2.

For example, convert 9 into binary as follows;

9/2 = 4 and remainder = 1 first remainder is called LSB (least significant bit)

4/2 = 2 and remainder = 0

2/2 = 1 and remainder = 0

1/2 = 0 and remainder = 1 last remainder is called MSB (Most significant bit)

Now, decimal 9 is equivalent to 1001 binary number

$$(9)_{10} = (1001)_2$$

MSB (Most significant bit) **LSB (least significant bit)**

2. Decimal to Octal Conversion

We can convert decimal to octal and hexadecimal by using the similar conversion method of decimal to binary. i.e., successive division, which requires dividing continuously by the base we are converting to until the quotient equals 0. The remainders compose the answer.

Steps for conversion from Decimal to octal

1. Divide the decimal number by 8.
2. Take the remainder and record it on the side.
3. Repeat until the decimal number can not be divided any more.
4. With the bits, record them in order from right to left as that will be the number in base 8.

For example, to convert 19 into Octal follow the steps:

19/8=2 and remainder = 3 first remainder is called LSB (least significant bit)

2/8=0 and remainder = 2 last remainder is called MSB (Most significant bit)

Now decimal number **19** is equivalent to octal number **23**

$$(19)_{10} = (23)_8$$

3. Decimal to Hexadecimal Conversion

Division method can be used for conversion from decimal to hexadecimal.

Steps for conversion from Decimal to Hexadecimal

1. Divide the decimal number by 16
2. Take the remainder and record it on the side.
3. Repeat until the decimal number can not be divided into any more.
4. With the bits, record them in order from right to left as that will be the number in base 16.

For example, to convert decimal number 229 into hexadecimal number:

229/16 = 14 and remainder = 5 first remainder is called LSB (least significant bit)

14/16 = 0 and remainder = 14 last remainder is called MSB (Most significant bit)

In hexadecimal 10,11,12,13,14,15 are equivalent to A,B,C,D,E,F respectively

So $(229)_{10} = (E5)_{16}$

4. Binary to decimal

To find the decimal representation of a binary number simply take the sum of products of binary digits and the powers of 2 which they represent.

For example,

Conversion of $(1000)_2$ into decimal is as follows:

$(1000)_2 = 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= 1 \times 8 + 0 \times 4 + 0 \times 2 + 0 \times 1$

$(1000)_2 = 8 + 0 + 0 + 0 = 8$

5. Octal to decimal

To find the decimal representation of an octal number simply take the sum of products of octal digits and the powers of 8 which they represent.

For example,

Conversion of $(1000)_8$ into decimal is as follows:

$(1000)_8 = 1 \times 8^3 + 0 \times 8^2 + 0 \times 8^1 + 0 \times 8^0$

$= 1 \times 512 + 0 \times 64 + 0 \times 8 + 0 \times 1$

$(1000)_8 = 512 + 0 + 0 + 0 = 512$

6. Hexadecimal to decimal

To find the decimal representation of a Hexadecimal number simply take the sum of products of hex number and the powers of 16 which they represent.

For example,

Conversion of $(1000)_{16}$ into decimal is as follows:

$(1000)_{16} = 1 \times 16^3 + 0 \times 16^2 + 0 \times 16^1 + 0 \times 16^0$

$= 1 \times 4096 + 0 \times 256 + 0 \times 16 + 0 \times 1$

$(1000)_8 = 4096 + 0 + 0 + 0 = 4096$

Now let us learn about one's complement and two's complement of a binary number.

2.2 ONE'S COMPLEMENT AND TWO'S COMPLEMENT

One's complement of a binary number can be achieved by changing all 0's to 1's and 1's to 0's.

Example:

There is a binary number 11001 and its 1's complement would be 00110 after all 0's to 1's and 1's to 0's.

Two's complement of binary number can be obtained by adding 1 to the LSB (Least Significant Bit) of 1's complement of binary number.

2's complement= 1's complement +1

Example:

Binary number: 11001

1's complement of number: 00110 (i.e. convert all 1's to 0's and all 0's to 1's)

2's complement of number= 00110+1=00111

2.3 CHARACTER CODING SYSTEM (ASCII, ISCII & UNICODE)

Computer works on character data and this data is not only alphabet but numeric values, punctuation; spaces, etc., are also character data. In common language whatever is on keyboard (except shift, caps lock key) are character data. As you know computer operates on binary values so these character are also represented in binary values. Most common character coding used in India are ASCII, ISCII and UNICODE.

ASCII

ASCII stands for *American Standard Code for Information Interchange*. Computers can only understand numbers, so an ASCII code is the numerical representation of a character such as 'A' has numerical value as 65. Some other characters and its equivalent ASCII values are following:

Table 2.1: ASCII codes table

ASCII	Hex	Symbol
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D

69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O

From the above table you can see, characters have equivalent ASCII values. Similarly, each character has ASCII value.

ASCII value for a to z is from 97 to 122 i.e., a = 97, z = 122.

Indian Script Code for Information Interchange (ISCII)

This coding scheme is used for Indian script and its symbols. Using this, it is possible to define a syllable boundary for Indian script word. It was developed by Bureau of Indian Standards in 1986 and revised to a more compact form in 1988. The table 2.2 shows few of the character set for Devanagari script -

Table 2.2: "first vowel of Hindi has numeric value 164"

अ 0905 164	आ 0906 165	इ 0907 166	ई 0908 167
उ 0909 168	ऊ 090A 169	ऋ 090B 170	ऐ 090E 171
क 0915 179	ख 0916 180	ग 0917 181	घ 0918 182
0 0966 241	1 0967 242	2 0968 243	3 0969 244

Unicode

Developed in 1987, Unicode provides a unique number for every character of all languages. It was developed to represent characters from a wide range of languages and can thus represent characters from English, French, Greek, Korean etc., all at

the same time. The first 256 places of Unicode are same as ASCII and it expands the character set for new and unique characters that may arise in future.

63	64	65	66	67
?	@	A	B	C
1036	1037	1038	1039	1040
Ќ	Ѝ	Ў	Џ	А
1048	1049	1050	1051	1052
И	Й	К	Л	М
1060	1061	1062	1063	1064
Ф	Х	Ц	Ч	Ш
1072	1073	1074	1075	1076
а	б	в	г	д

Fig. 2.1: Unicode Representation

2.4 LOGIC GATES

Logic gates are elementary building block of a digital circuit. Most logic gates have two inputs and only one output. The basic logic gates are AND, OR and NOT, NAND, NOR, XOR and XNOR. In this lesson, let us learn about AND, OR, NOT, NAND and NOR logic gates. Binary logic deals with true and false. You know that 0 is usually associated with false and 1 is associated with true.

Example

(a) 1 + 0 = 1 (True)

(b) 0 + 1 = 1 (True)

(c) 0 + 0 = 0 (False)

(d) 1 + 1 = 1 (False)

2.4.1 AND gate

This gate acts in the same way as the logical operator 'and' works. An AND operation produces an output of logic-0 if at least one of the input is zero. Output will be logic-1 if all the inputs are logic-1. Truth table of AND operation is shown

below. A truth table is a list of all possible combination of input logic levels along with corresponding output level (refer to Table 2.3).

Table 2.3: Truth Table for AND operation

Input		Output
A	**B**	**C = A.B**
0	0	0
0	1	0
1	0	0
1	1	1

The equation for logic AND operation

$$C = AB$$

AND gate representation

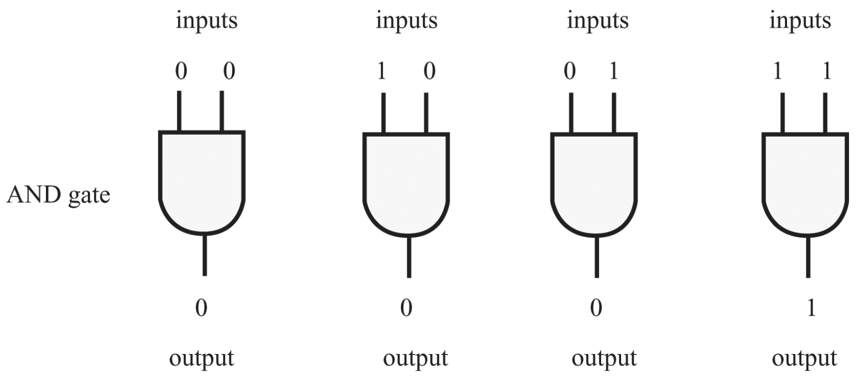

Fig. 2.2: AND gate

2.4.2 OR gate

This operation is represented by plus (+) sign. The OR gate produces an output of logic-1 if at least one of the inputs is logic-1.

Truth table of OR operation is given in Table 2.4

Table 2.4: Truth Table for OR operation

Input		Output
A	**B**	**C = A + B**
0	0	0
0	1	1
1	0	1
1	1	1

Equation of OR operation: $C = A + B$

OR gate representation

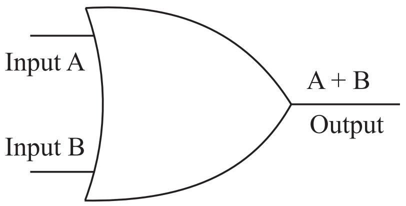

Fig. 2.3: OR Gate representation

In the above representation A,B are inputs and the output is A+B.

2.4.3 NOT operation

The NOT operation represents complement or inverse of inputs. A prime or bar represents this operation. The truth table for NOT operation is given in Table 2.5.

Table 2.5: Truth table for NOT operation

(Input)	(Output)
A	$\bar{A}$
0	1
1	0

NOT gate representation

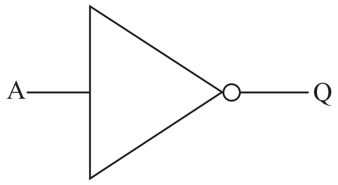

Fig. 2.4: NOT Gate representation

Equation for NOT operation

$$Q = \bar{A}$$

Other operations are combination of AND, OR and NOT. They are NOR and NAND.

- NOR operation is combination of OR and NOT. NAND operation is combination of AND and NOT.

- NAND and NOR operations are also known as universal operations because you can generate any other operation through it. These gates are called **Universal Gates**.

2.4.4 NOR Operation

It is the NOT-OR gate. The output is true when neither A nor B is true. If any one of the input variables is true then output is false. NOR gate represents complement of the OR operation. The graphic symbol for the NOR gate consists of an OR symbol with a bubble on the output, denoting that a complement operation is performed on the output of the OR gate.

Table 2.6: Truth table of NOR operation

Input		Output
A	**B**	**C = $\overline{A + B}$**
0	0	1
0	1	0
1	0	0
1	1	0

NOR gate representation

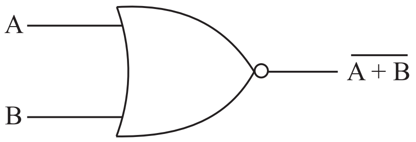

Fig. 2.5: NOR Gate representation

Equation for NOR gate

$$C = (A + B)^1 \text{ or } \overline{A + B}$$

2.4.5 NAND Operation

The NAND gate represents the complement of the AND operation. The graphic symbol for the NAND gate consists of an AND symbol with a bubble on the output, denoting that a complement operation is performed on the output of the AND gate.

Truth table of NAND operation is given in Table 2.7.

Table 2.7: Truth table of NAND operation

Input		Output
A	**B**	**C = $\overline{A \cdot B}$**
0	0	1
0	1	1
1	0	1
1	1	0

NAND gate representation

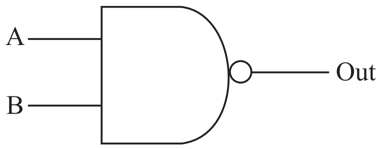

Fig. 2.6: NAND Gate representation

Equation for NAND gate

$$C = \overline{A \cdot B} \text{ or } (A \cdot B)'$$

NAND and NOR gates are called universal gates as they can implement any type of boolean expression.

> *Other two primary logic gates are XOR - Exclusive OR gate and XNOR - Exclusive NOR gate. In case of XOR gate the ouput is 1 only when one of inputs is 1. In case of XNOR gate the output is 1 when the both the inputs are the same*

INTEXT QUESTIONS 2.1

State whether the following statements are true or false:

1. Binary logic works on two states.
2. "ON" state is represented by 0.
3. The NOR gate represents the complement of the OR operation.
4. The binary number system is a system of two digits-0 and 1.
5. 1 = 0 AND 1.

WHAT YOU HAVE LEARNT

- A computer stores and processes two basic types of data viz.,character and number.
- Binary numbers are combination of zeroes and ones.
- Octal or oct number uses digits 0 to 7.
- ASCII stands for *American Standard Code for Information Interchange*.
- ISCII stands for Indian Script Code for Information Interchange (ISCII)
- Basic binary operations are AND, OR and NOT that can be described in the form of GATEs. These gates are known as logic gates.
- NAND and NOR are universal gates because all operations can be performed through it.

TERMINAL EXERCISE

1. Define AND gate and its operation.
2. Differentiate between AND & OR gates.
3. What is a universal gate?
4. How can you create NOR gate using OR and NOT gate?
5. Convert $(990)_{10}$ into binary.

ANSWERS TO INTEXT QUESTIONS

2.1

1. True
2. False
3. True
4. True
5. False

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3

COMPUTER SOFTWARE

In the previous lesson, you have learnt about binary logic. Now you will be able to understand the working of computer. As you know that computer is a machine which cannot do anything without instructions from the user. In order to do any specific job you have to give a sequence of instructions to the computer. These set of instructions are called as programs and these set of computer programs are called as software. In this lesson, you will learn about computer software, computer languages and translators.

OBJECTIVES

After reading this lesson, you will be able to:

- define software;
- distinguish between system software and application software;
- identify various levels (or generations) of language such as machine language, assembly language, high-level language;
- compare compilers and interpreter.

3.1 WHAT IS SOFTWARE

Computer system is broadly classified as hardware and software. Hardware means physical components of the computer system. We can say that hardware cannot perform any calculation, comparison or manipulation without being instructed to do so. These instructions play a vital role in the performance of a computer. A complete set of instructions written to solve a problem on a computer is called software. i.e., software refers to the set of computer programs that cause the hardware (computer system) to function in the desired manner.

Computer software is normally classified into two broad categories:

(i) System Software

(ii) Application Software

3.1.1 System Software

System software includes general programs written for a computer. It consists of pre-written programs and documentation supplied by the manufacturer along with the computer. These programs are held permanently in the machine. The primary objectives of this software are to:

(i) enhance the efficiency of hardware utilization, and

(ii) make computers simple to use.

The first objective is realized by that component of system software which is commonly known as operating system. System software is a set of instruction to the machine to interpret and execute application software. For example, language translators (called compilers and interpreters), operating systems, utilities and special purpose software.

Operating System

An operating system is the most important system software and it is an essential software to operate the computer system. An operating system manages computer's resources very effectively, takes care of scheduling multiple jobs for execution and manages the flow of data and instructions between the input/output units and the main memory.

Operating system like Microsoft Windows, Linux are examples of system software.

The first operating system, called batch processing operating system was developed for the second generation computers. This operating system executes jobs serially one after another from a batch of jobs submitted for execution. The central processing unit is kept busy only during the processing cycle of a job and remains idle during the input and output operations. A multi programming operating system handles multiple jobs simultaneously by overlapping the input/ output and processing cycles of various jobs.

Other types of operating system which are popular today are 'multi-processing operating systems' and 'real time operating systems'. A multi-processing operating system uses multiple CPUs to process multiple jobs. A real time operating system is a type of interactive operating system with strict time limitation. Receiving and processing data is done quickly enough to produce output, to control, direct or effect the outcome of ongoing activity. The reservation system used by railway, airlines, and hotel are the examples of real time applications.

An operating system governs the working of the computer and input/output devices. The operating system programs act as an interface between the user's programs and the computer's components and helps in the execution of user's programs. The major functions of an operating system are:

(i) User identification and managing of the resources used by the users. Thus un-authorized users cannot use the computer.

(ii) Sharing of computer resources among many users. The sharing is achieved by permitting simultaneous executions of more than one user program. This is usually called multi-programming. A mix of programs can keep the whole memory occupied, all devices active, and the control unit and ALU constantly busy, thus increasing utilization of hardware.

(iii) Executive batches of programs, one after another, without human intervention.

(iv) Protection of user's data and programs.

(v) Controlling the transfer of data and programs between the main memory and secondary storage and other I/O devices.

(vi) Providing programs to select appropriate translators.

(vii) Providing facilities to detect and correct errors in a user's program.

An operating system understands a fixed set of commands. This set of commands is often called Job Control Language (JCL). The JCL commands are used by the computer users to indicate their requirements to the operating system. The operating system which is used with a micro-computer is called CP/M (control program for microprocessor). Another operating system which is gaining popularity and which is available on a variety of different machines is UNIX (UNIX was developed by Bell laboratories). You will be learning more about operating system in the lesson 4.

Utility Software

Utility software may be considered as system software which is used quite often in the development of a program. Sort merge programs are used to sort records in a particular manner or sequence. Such programs are normally provided by the manufacturers. The programmer can also develop his/her own utility software and keep it in the secondary memory of the computer.

3.1.2 Application Software

Application software is written to perform a specific task or process, such as accounting, payroll, mailing list, result preparation and so on. The majority of application software is written in high-level languages.

Notes

Assuming that the task to be carried out has been correctly identified, carefully defined, the prospective user will come across the following alternative sources for this application software.

Application Software

- Write it yourself
- General purpose package
- Customized software

(a) **Write it yourself** : The program written by the user can be the most satisfactory solution. It will be an exact match to the needs of the business. The program can grow with the business.

(b) **General purpose application packages** : Application packages refer to a set of computer programs, which have been written to perform specific, commonly required tasks. Each program is written in such a way that it is applicable to a large number of users. The main advantage is that it is relatively cheap as cost of the package is spread over a number of customers.

The major disadvantage of application package is that it is not likely to fulfil all the requirements of the prospective users.

(c) **Customized software** : It refers to computer programs specially written to match the exact needs of the user. The most important advantage is that such software fulfils all the needs of the customer. The major disadvantage is that customised software costs much more than general purpose application software, because the package is specially made for one particular customer.

Common Application Packages

Some of the common requirements of the users of personal computers have been identified and common applications packages have been developed to meet their needs. These packages include word processor, database processing, spreadsheet calculations, mail-merge, presentations and communications (email). These packages have been prepared so that they are simple to use. They also provide graphical user interface to make them very user friendly. These packages are readily available in the market and one can purchase them, install it on his/her computer easily and start using the package.

INTEXT QUESTIONS 3.1

1. State whether the following statements are true or false.

   (a) Computer software is normally classified into two broad categories. Those are system software and application software.

(b) An operating system is an essential software to operate a computer system.

(c) JCL stands for Job Common Language.

(d) Application software is written to perform a specific task or process.

(e) Utility software cannot be considered as an application software.

3.2 COMPUTER LANGUAGE

You know that software is a set of computer programs. These computer programs will be written in the language what computer understands. If you want to get something done by a person, you will tell him what to do in a language that he understands. Similarly, if you want to get some work done by the computer, you have to tell the computer in a language that the computer understands, i.e., machine language. The machine language consists of only binary digits, i.e. 0 and 1. It was felt quite difficult and tedious for human beings to think in binary numbers. For communicating with the computer, it was thought that it is advisable to develop a third language, a programming language that can be understood by both human beings and the computer. Thus a programming language is a set of rules that provides a way of instructing the computer to perform certain operations.

Programming languages are said to be lower or higher, depending on whether they are closer to the language the computer itself uses (lower, which means 0s and 1s) or to the language that people use (higher, which means more English like).

The languages in which programs are written are called programming languages. These languages can be classified into following categories.

- Machine language
- Assembly language
- High level language

Machine Languages

Do you know that computer can understand 0's and 1's? Yes 0's and 1's can be directly understood by computers. Programs that have only binary digits are called a machine language programs. It is difficult to write or understand machine language. Letters of the alphabet are also represented in binary numbers. In one system, the letter A is represented as 1000001. Commas, semicolons and other special characters are also represented as bunches of 0s and 1s.

Assembly Languages

In the 1950s, to reduce programming complexity and provide some standardization, assembly languages were developed. Assembly languages, also known as symbolic

languages use abbreviations or memonic code - codes that are more easily memorized to replace the 0s and 1s of machine languages.

The hypothetical machine language segment we saw above is as follows:

11110010 01110011 11010010 00010000 01110000 00101011

This could be expressed in assembly language statement as :

PACK 210 (8, 13), 02B (4,7)

Actually, assembly languages do not replace machine languages. In fact, for an assembly language program to be executed, it must be converted to machine code. The assembly language program is referred to as a 'source program' whereas, the machine language program is an 'object program'.

Assembly language code is very similar in the form to machine language code. In fact, assembly languages had a one-to-one correspondence which means that 15 assembly statements, would be translated into 15 machine language statements. This one-to-one correspondence was still laborious. However, assembly language instructions (called macro instructions) were devised, which executed batches of one-to-one instructions.

Assembly languages offer several advantages:

- They are more standardized and easier to use than machine languages.
- They operate very efficiently, although not as efficient as the machine languages.
- They are easier to debug.

However, there are still some disadvantages:

- Assembly language programs are usually very long and difficult to debug.
- Though less abstract than machine languages, assembly language programs are still complex.
- Though more standardized than machine languages, assembly languages are still machine dependent.

High Level Languages

High Level Languages helped programmers by reducing further the number of computer operations details they had to specify, so that they could concentrate more on the logic needed to solve the problem.

Basic, C, C++, Java, Perl and COBOL are the example of high level language (HLL)

Languages are often referred to as generations, the idea being that machine languages were the first generation and assembly languages were the second

generation. High-level languages are sometimes used to refer all languages above the assembly level. Here we will subdivide high-level languages into three generation.

- Procedural-oriented or third generation
- Problem-oriented or fourth generation
- Natural or fifth generation

Procedural-oriented Languages

High-level languages are often classified according to whether they solve general problems or specific problems. General-purpose programming languages are called procedural languages or third generation languages. These are languages such as Pascal, BASIC, COBOL, and FORTRAN, which are designed to express the logic, the procedure, of a problem. Because of their flexibility, procedural languages are able to solve a variety of problems.

Procedural languages have many advantages over machine and assembly languages:

- The program statements resemble English language and hence are easier to work with.
- Because of their English-like nature, less time is required to develop a program for a given problem.
- Once coded, programs are easier to understand and modify.
- The procedural languages are machine-independent.

However, procedure-oriented languages still have some disadvantages compared to machine and assembly languages:

- Programs are executed more slowly.
- The languages use computer resources less efficiently.

Problem-oriented Languages and Application Generators

Third-generation languages, such as BASIC or Pascal, require you to instruct the computer in step-by-step fashion. Fourth-generation languages, also known as problem-oriented languages, are high-level languages designed to solve specific problems or develop specific applications by enabling you to describe what you want rather than step-by-step procedures for getting there.

Table 3.1 summarizes some of the major difference between third-generation languages (3GLs) and fourth-generation languages (4GLs).

Table 3.1: Difference between 3 GLs and 4 GLs

Third-generation Languages	Fourth-generation Languages
Intended for use by professionals	May be used by a non-programming personnel as well as a professional programmer.
Requires specification of how to perform task.	Requires specification of what task is to be performed (system determines how to perform the task).
All alternatives must be specified.	Default alternatives are built in; an end user need not specify these alternatives
Require large number of procedural instructions.	Require fewer instructions.
Code may be difficult to read, understand and maintain.	Code is easy to understand and maintain because of English-like commands.
Language developed for batch operations.	Language developed primarily for online use.
Can be difficult to learn.	Easy to learn.
Difficult to debug.	Easy to debug.
Typically file-oriented	Typically database-oriented.

Natural Languages

Natural languages are still in the developmental stages, but they promise to have profound effect, particularly in the areas of artificial intelligence and expert systems. Natural languages have two characteristics:

- They are designed to make the connections that humans have with computers more natural - more human like.
- They are designed to allow the computer to become "smarter" - to actually simulate the learning process by remembering and improving upon earlier information.

Two popular natural languages are LISP and PROLOG.

3.3 COMPILERS AND INTERPRETERS

For a high-level language to work on the computer it must be translated into machine language. There are two kinds of translators - compilers and interpreters. High-level languages are called either compiled languages or interpreted languages. In a compiled language, a translation program is run to convert the high-level

language program (which is called the source code) into a machine language code. This translation process is called compilation. The machine language code is called the object code and can be saved and either run (executed) immediately or later. Some of the most widely used compiled languages are COBOL, C, C ++, FORTRAN, etc.

In an interpreted language, a translation program converts each program statement into machine code just before the program statement is to be executed. Translation and execution occur immediately, one after another, one statement at a time.

Unlike the compiled language, no object code is stored and there is no compilation. The most frequently used interpreted language is BASIC.

Compiled languages are better than interpreted languages as they can be executed faster and more efficiently once the object code has been obtained. On the other hand, interpreted languages do not need to create object code and so are usually easier to develop and test.

Compiler reads the entire program for compilation. Interpreter reads single statement at a time for interpretation.

INTEXT QUESTIONS 3.2

1. State whether the following statements are true or false:
   (a) Machine language is machine-dependent.
   (b) Assembly language is second generation language.
   (c) A program written in a high level language is called an object program.
   (d) Portability is one of the features of high level language.
   (e) Query languages allow people who are not programmers to search a database using certain selection commands.

WHAT YOU HAVE LEARNT

- A complete set of instructions written to solve a problem on a computer is called software. i.e., software refers to the set of computer programs that cause the hardware (computer system) to function in the desired manner.
- Computer software is normally classified into two broad categories (i) system software and (ii) application software.
- System software includes general programs written for a computer.
- Application software is written to perform a specific task or process.

- Programming languages can be classified as machine language, assembly language and high-level language.
- Machine language and assembly language programs are difficult to write and read. High level languages are easy to learn and write.
- Compiler and interpreter convert the program written in high level language into machine language code.
- A translation program is run to convert the high-level language program, which is called the source code, into a machine language code. This translation process is called compilation.

TERMINAL EXERCISE

1 Write any one difference between hardware and software.
2 What are the advantages and disadvantages of machine language?
3 What is the difference between source program and object program?
4 Explain assembly language. What are its advantages over machine language?
5 Define operating system. Write down its various functions.
6 Describe briefly about application software.

ANSWERS TO INTEXT QUESTIONS

3.1

1. (a) True (b) True (c) False (d) True (e) True

3.2

1. (a) True (b) True (c) False (d) True (e) False

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4

OPERATING SYSTEMS

In the previous lesson you have learnt about computer software. An operating system is system software that runs on a computer. Every computer must have an operating system to run other programs and applications. An operating system (OS) is a program that acts as an interface between the user and the computer hardware. Without an operating system, a computer and software programs would be useless. Operating system performs basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers. In this lesson, you will learn about functions of operating system and types of operating system.

OBJECTIVES

After reading this lesson, you will be able to:

- define operating system;
- list the functions of operating system;
- classify operating system.

4.1 OPERATING SYSTEM

A computer is a machine which needs to be instructed for every single step. The operating system is the most important software that runs on a computer. The OS performs the following functions.

- It provides a convenient and an efficient environment for users to execute programs.
- It is a software which manages hardware.

- An operating system controls the allocation of resources like memory, processors, devices, and information.
- It makes sure that different programs and multi-users do not interfere with each other.

Computer system cannot operate without an operating system. Some of the most common operating systems are is Windows operating systems (by Microsoft), Macintosh operating systems (by Apple) and UNIX family of operating systems. There are many operating systems which are available for special-purpose applications, including specializations for mainframes, robotics, real-time control systems and so on.

There are certain standard services which are required by every application program (like music player, word processor, games, etc.). A few examples of services which are provided by the operating system are:

1. While listening to music on the media player, it works to retrieve the music from its source. The operating system sends the information from the music player to the speakers so that we can hear the music.
2. The OS sends the signals to the printer when the word processing program prints the output on the paper.
3. On a network, where more than one computer shares a printer or other resource, the OS will coordinate those activities.
4. Managing memory when multiple programs are running. For example, listening to music and writing your notes in the word processor are two different applications which are allocated memory by the OS.

Thus, for users, it does the basic management of hardware and software resources and sets the system to look and perform the way they want it.

OS, is a collection of software that manages computer hardware resources and provides common services for computer programs. It deals with management and coordination of its activities. The operating system is a vital component of the system software in a computer system.

4.2 FUNCTIONS OF OPERATING SYSTEM

The operating system manages computer resources, especially the allocation or assignment of the resources among other programs. Management tasks include scheduling the resources to avoid conflicts and interference between programs.

The various functions of operating system are shown in Fig. 4.1.

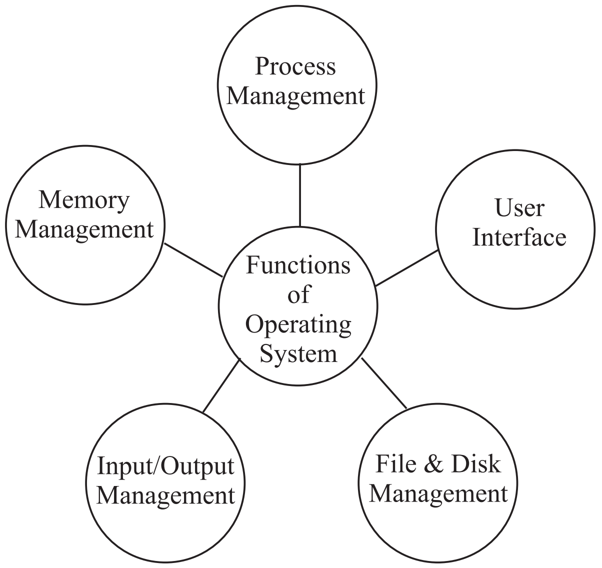

Fig. 4.1: Functions of Operating System

Let us now discuss each function in detail.

4.2.1 Process Management

We know that a program is a set of logical instructions given to the computer. A program that is in an execution state is called a **process**. For example, a word processing program like MS-Word being run by a user on a personal computer is a process. A system task, such as sending output to a printer, can also be a process.

A process needs certain resources-such as CPU time, memory, files and I/O devices to accomplish its tasks. These resources are allocated to the process either when they are created or while they are executing. The operating system helps in the allocation of resources to each process. The most critical task for an operating system is allocation of the CPU time. Each process is allowed to use the CPU for a limited time, which may be a fraction of a second. It must then give up control and thus becomes suspended until its next turn. Thus, to maximize CPU utilization and allow multiple processes to run, process scheduling is performed by the OS. The operating system is responsible for creation, deletion, and scheduling of various processes that are being executed at any point of time.

4.2.2 Memory Management

A computer program remains in main (RAM) memory during its execution. To improve CPU usage several processes are being executed simultaneausly in the memory. The OS keeps track of every memory location, that is either assigned to some process or is free. It also checks how much memory should be assigned to each process.

4.2.3 Input/Output Management

Humans interact with machines by providing information through input output devices. Management of input/output (I/O) devices is one of the most important functions of an operating system. A few examples of the variety of input/output devices on a modern computer are- mouse, keyboards, disk drives, USB devices, I/O, printers, special devices for the physically challenged, etc. Operating system provides a generic, consistent, convenient and reliable way to access I/O devices.

OS responds to the user keystrokes, mouse clicks and other input formats. It then interprets the I/O requests so that requested input/output functions can be performed. For this the operating system requires device driver software to interact with a particular hardware device.

4.2.4 File and Disk Management

Computer systems have secondary storage devices like magnetic disk, magnetic tape, optical media, flash drives, etc. for permanent storage of programs and data. The programs and the user data are stored in files. In general, a file is a sequence of bits, bytes, lines or records. The operating system is responsible for allocating space for files on secondary storage media. A file, especially a large file, may or may not be stored in a contiguous location on a physical disk drive. If the file is of large size, it is fragmented into smaller pieces. The OS then keeps track of the memory location allocated to each piece of the file on the storage disk.

The operating system is thus responsible for the organisation of the file system. It guarantees that the read and write operations performed on the secondary storage device are secure and reliable. The operating system must be able to read, write and search each file whenever it is required, keeping the access time to the minimum. Operating systems like DOS, Windows, Macintosh and Unix follow the hierarchical structure to store files and folders, e.g. in case of windows, a file is placed in the desired folder or a subfolder.

4.2.5 User Interface

A User Interface (UI) is the part of an operating system, program or device that the user uses to input and receive data. A **Text User Interface** (TUI) or **Command Line Interface** (CLI) allows users to interact with an operating system by typing commands in a terminal or console window. The users type a command or series of commands for each task they want to perform on a visual prompt. Examples of command line based operating systems are DOS (Disk Operating System), and UNIX etc.

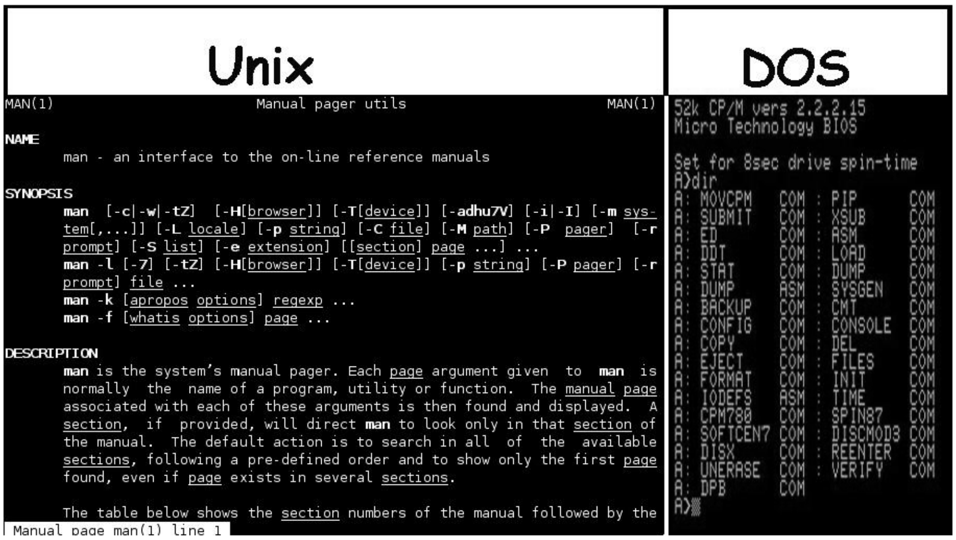

Fig. 4.2: Screenshot of UNIX and DOS window

Graphical User Interface (GUI) is an easy to use interface. It uses graphics, along with a keyboard and a mouse, to provide an easy-to-use interface to a program. A GUI makes interaction for the user easy with the operating system or applications because it provides you with features like pull-down menus, buttons, scrollbars, iconic images, wizards and other icons. Examples of GUI operating systems are Windows, Linux, and Solaris.

Fig. 4.3: GUI Operating Systems

Difference between GUI and CLI

Basis	GUI	CLI
Ease	GUI is very easy to interact with the computer. For example, application programs, commands, disk drives, files etc., are presented in the form of icons. You can click using mouse on these icons. GUI also provides menus, buttons and other graphical objects to the user to perform different tasks.	The new users find it difficult to use the command line interface since, it requires memorization of commands.

Control	GUI provides a lot of control over the file system and the operating system but still to perform some advanced level tasks command line is required.	Some advanced level tasks can be performed only through commands. Users using command line interface get much more control over the operating system and the file system. For example, a single line command may be used to copy a file from one location to the other.
Resource	In the case of GUI, a lot of system resources are required, because each component such as drivers for video, mouse and other devices also needs to be loaded.	Very few computer resources are needed when the system is running.
Example	Windows, Macintosh, Linux	UNIX,MS-DOS

INTEXT QUESTIONS 4.1

I. Choose the appropriate answer.

1. What is an Operating system?
   - (a) Collection of programs that manages hardware resources
   - (b) System service provider to the application programs
   - (c) Link to interface the hardware and application programs
   - d) All of the above

2. Process is ....
   - (a) Program in high-level language kept on disk.
   - (b) A program in execution.
   - (c) Contents of main memory.
   - (d) A job in secondary memory.
   - (e) None of the above.

3. An .... is an intermediary between users and computer hardware.
   - (a) Operating environment
   - (b) Operating System
   - (c) System Software
   - (d) None

II. Fill in the blanks.

1. .... and .... are two types of user interfaces.

2. ...., ..., ..., ... are all the resources managed by operating system.

3. .... is an example of GUI based OS.

4.3 TYPES OF OPERATING SYSTEM

There are many different operating systems that have been developed for different purposes. The most typical OS in ordinary desktop computers and laptops are Microsoft Windows, Linux, UNIX, etc.

4.3.1 Microsoft Windows

Windows is an operating system designed by Microsoft. It is the most popular OS for home PCs. There have been many versions of Windows, but the most recent ones include Windows 10 (released in 2015), Windows 8 (2012), Windows 7 (2009), Windows Vista (2007).

Fig. 4.4: Windows 10 Operating system

Features of Microsoft Windows Operating System

(a) It is GUI based operating system, i.e., interaction with the computer is done by clicking with mouse on the icons. GUI also provides menus, buttons

and other graphical objects to the user to perform different tasks. GUI is very easy to interact with the computer. Thus, Windows eliminate the need to memorize commands for the command line (MS-DOS).

(b) Several programs can be opened at the same time, i.e., it supports multiprogramming and multitasking.

4.3.2 Linux

Linux is an open-source operating system. The term open source refers to program code which is freely available and its source code is available to developers or users for modification. Linux typically provides two GUIs: KDE and Gnome. The various distributions of Linux come from different companies like Red Hat, SuSE, Ubuntu, Xandros etc.

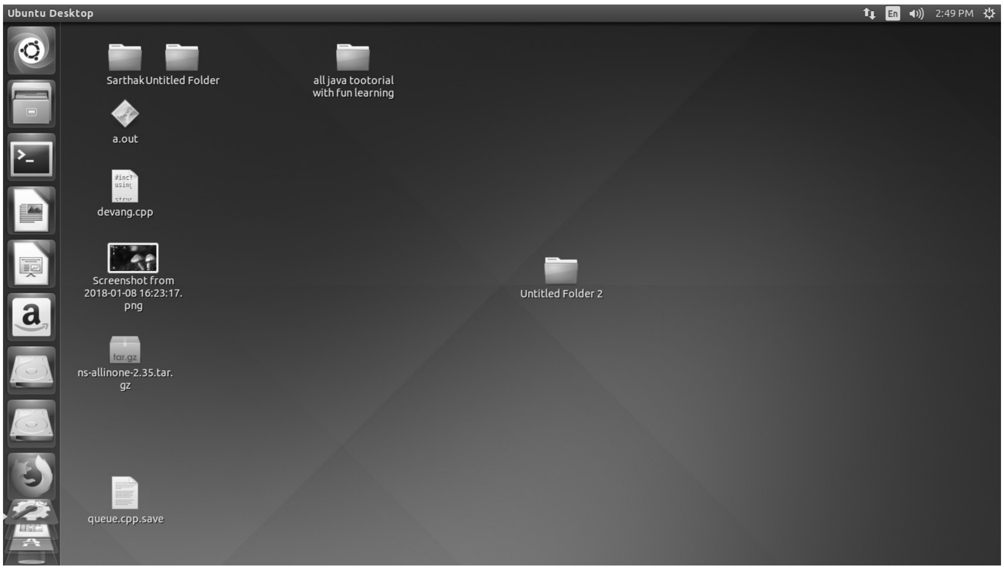

Fig. 4.5: Linux operating system

Linux operating system has three main components.

(i) Kernel - Core part of Linux. It is responsible for major activities of operating system.

(ii) System library - It has special functions using which application programs access Kernel's features.

(iii) System utility - It is responsible to do specialized, individual level tasks.

Features of Linux Operating System

(a) It is an open source OS. Open source refers to any program whose source code is made available for use or modification. Open source software is usually developed as a public collaboration and made freely available.

(b) It is a multi-user system operating system that supports multiple users at once or different times.

Linux is customizable in a way that Windows is not. The user interface, while similar in concept, varies in detail from distribution to distribution.

4.3.3 UNIX

UNIX is an operating system developed in the 1960s. It is a stable, multi-user, multi-tasking system for servers, desktops, and laptops. There are many different versions of UNIX, although they share common similarities. The most popular versions of UNIX are Sun Solaris and MacOS X.

Features of UNIX Operating System

(a) UNIX is a flexible operating system. It can be installed on many different types of machines like main-frame computers, supercomputers, and micro-computers.

(b) UNIX has better built-in security and permissions features than Windows.

4.3.4 Smartphone Operating Systems

Smartphones are using operating systems too. This development has brought many advanced functions on mobile which were already available on our computer. Mobile phones or smartphones are not just a device to make phone calls or send some texts, but they are close to handheld computers that enable us to send email, play games, watch news, do video calls and much more. It is also a platform where developers can create applications or 'app' (software programs developed for smartphones that can perform specific functions). There are thousands of apps available, and they are constantly evolving - each with its distinct purpose. For example, you can download weather app that tells you the current temperature or possibility of rain in your city.

Let us learn about some of the smartphone operating systems in detail.

(a) iOS

Apple iOS is a multi-touch, multi-tasking operating system that runs on Apple iPhone, iPad, and iPod. It gives the response on the user's touch. It allows them

Notes

to tap on the screen to open a program, enlarge an image, or swipe a finger on the screen to change the pages. Apple iOS can only be used by products made by Apple. It comes with the Safari web browser for internet access, iTunes application for playing music, and Mail app for accessing mail. You can download millions of apps like recipe books, guitar tutorials, games or any other app of your interest available on the App Store on any Apple device running iOS.

Fig. 4.6: iOS Home Screens Evolution

(b) Android

Android is an open source mobile operating system owned by Google. You can find a wide range of devices from smartphones, to Android TV'S, tablets etc. which use Android as OS. The source code of the open software is available i.e., the source code can be viewed, altered and shared. Open source operating systems are fully customizable. It provides unlimited access to anyone who wants to develop apps for the phone and puts less restriction on its licensing, so users benefit from the free content. Android smartphone has a wide range of customers now. The Android market has millions of apps, most of which are totally free.

Fig. 4.7: Android based smart phones

Notes

(c) Windows Phone

Microsoft released its Windows platform for mobile phones in late 2010.The Windows phone home screen resembles a Window's Desktop start menu. Windows phone is recognizable from its tile-based interface. The Home screen is fully customizable to add or remove tiles (square / rectangular shaped selectable icons), resize tiles and move them around on the screen to reorganize. The content like photos, music, etc. from various applications are automatically grouped together by the aggregator feature called hubs. Aforementioned enables easy access to similar content in one place for the user without opening individual applications. For example, all the photos from the mobile camera, downloaded from apps like Facebook, etc. are shown in a single location. Windows OS comes with Internet Explorer for web access and Microsoft Exchange for secure corporate emails access. These applications have been optimised for mobiles.

Fig. 4.8: Windows Phone

INTEXT QUESTIONS 4.2

Fill in the blanks.

1. ...., ..., ... are some of the smartphone operating systems.

2. .... operating system is developed by Microsoft.

3. Linux is an .... operating system.

4. .... and .... are widely used as server operating system.
5. .... is the latest version of Windows.
6. Software programs developed for smartphones that can carryout specific functions are called as ....
7. .... is an open source mobile OS and is developed by ....

WHAT YOU HAVE LEARNT

- An Operating System (OS) is an interface between users and computer hardware. It provides users an environment in which a user can execute programs conveniently and efficiently.
- An operating system controls the allocation of resources and services such as memory, processors, devices and information.
- A file is a collection of related information that is recorded on secondary storage device.
- Multiprogramming is the ability of an operating system to execute more than one program on a single processor machine. More than one task/program/job/process can reside into the main memory at one point of time.
- A multiuser operating system is a computer operating system (OS) that allows multiple users on different computers or terminals to access a single system with one OS on it.
- Multitasking is the ability of an operating system to execute more than one task simultaneously on a single processor machine. Though we say so but in reality no two tasks on a single processor machine can be executed at the same time. Actually CPU switches from one task to the next task so quickly that appears as if all the tasks are executing at the same time.

TERMINAL EXERCISE

1. State all the important functions of operating system. Explain with the help of diagrams.
2. Explain all the functions of operating system.
3. What are the advantages and disadvantages of GUI based operating system?
4. Explain different types of smartphone operating systems.

5. What do you understand by open source software? Give some examples.
6. What is the difference between Windows and Linux operating systems?

ANSWERS TO INTEXT QUESTIONS

4.1

I.

1. d) All of the above
2. b) A program in execution
3. b) Operating System

II.

1. GUI and CUI
2. Memory, file, input/output, process
3. Windows

4.2

1. Android, iOS, Windows
2. Windows
3. Open Source
4. Linux and Unix
5. Windows 10
6. Apps(application)
7. Android, Google

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5

DATA COMMUNICATION AND NETWORKING

You have learnt about operating system and their functions, in the previous lesson. Now-a-days most people are using computers in their offices, homes, markets etc. Modern technology facilitates people to connect, share, and communicate with people sitting on one computer to another computer at different place. Data communications refers to the transmission of this digital data between two or more computers and a computer network or data network is a telecommunications network that allows computers to exchange data. The physical connection between networked computing devices is created using either a cable or wireless device. Internet, for example, is a prime example of networked computers communicating with each other using data transfer mechanisms. This lesson will introduce you the various aspects of computer network and data communications.

OBJECTIVES

After reading this lesson, you will be able to:

- describe basic elements of data communication system, transmission modes, digital and analog transmission;
- summarize communication terminologies (E-M spectrum, band, bandwidth and transfer rate);
- explain transmission media;
- list network devices (modem, RJ45 connector, ethernet card etc.);
- define malwares: virus, spam, hacking etc.;
- secure your system.

5.1 DATA COMMUNICATION

In our day to day life we communicate with people around us by using telephone, mobile and letters. In the same way, computer can communicate or send information to another computer system placed anywhere in the world. All this is possible using some standard methods. These methods basically use electrical signals carried along a conductor, optical fibres or over wireless devices using satellites. The most fundamental unit of exchange is in the form of bits (0s and 1s) between two devices. Such information is encoded and then decoded at the beginning and end of data communication channels so that it is easily understood by humans.

For example, a computer teacher wants to convey some messages to his/her students. He will send the message from his computer (central computer) and all the students will receive the message on other computers connected to the central computer through networking. All this can happen in few seconds. So we can say that people can send or get information or communicate with people through e-mail. This is possible because of computer networking. So sending an email is an example of data communication via computer network called Internet. Note that data communication has a subtle difference from telecommunication as we know it. Data communication in the specific context of this lesson refers to data exchange between computers.

5.1.1 Basic Elements of Communication System

The symbolic diagram of communication system is shown in Fig. 5.1

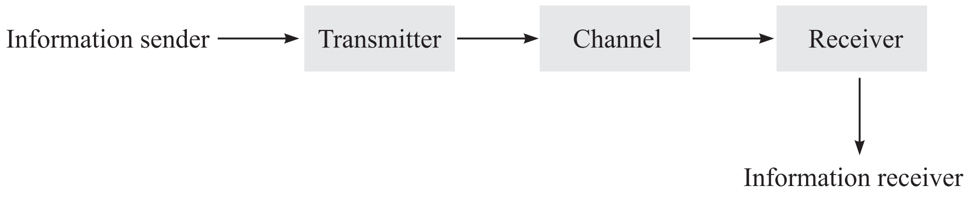

Fig. 5.1: Symbolic Diagram of Communication System

Basic elements of communication system are as follows-

Transmitter – converts the information in a suitable form before transmission.

The Channel – The physical medium or the communication channel used to send the information from the transmitter to the receiver.

The Receiver – It receives the information transmitted by the transmitter.

5.1.2 Transmission Modes

There are three ways of transmitting data as shown in Fig. 5.2.

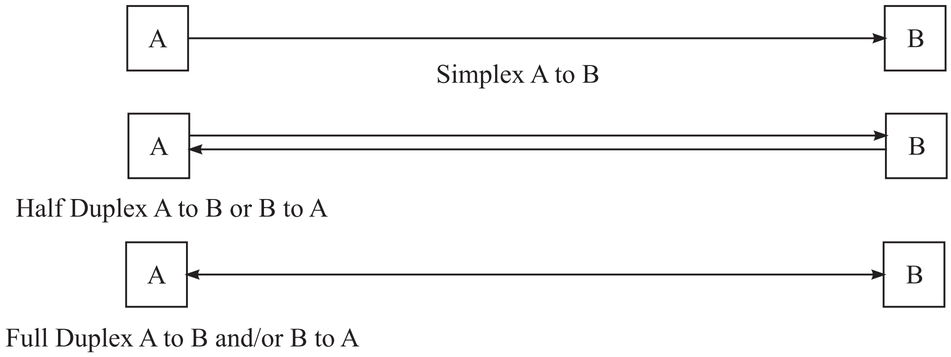

Fig. 5.2: Ways of Transmitting Data

Three types of transmission modes are-

Simplex: In this type of transmission, data can be sent only in one direction i.e., it's a uni-directional mode. The receiver only receives the data, but can not communicate back to the sender.

Half Duplex: In half duplex system, we can send data in both directions but sender can either receive the data or send the data at a particular time. So when the sender is sending the data, it cannot receive the data and vice versa.

Full Duplex: In this mode, we can send data in both directions as it is bidirectional mode. We can send and receive data at the same time.

5.1.3 Analog and Digital Transmission

Analog and digital transmission signal diagrams are shown in Fig. 5.3 below.

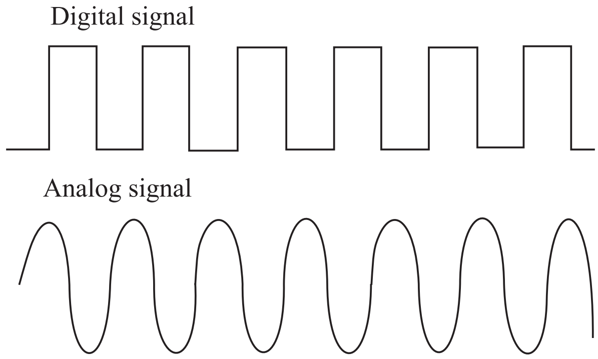

Fig. 5.3: Analog and Digital Signal Transmission

Data is transmitted from one point to another point through electrical signals that may be in digital or analog form.

Notes

Analog Transmission: In this transmission, information changes continuously and can take on many different values. It uses a continuous signal to transmit voice, data, image or other information between two systems. For example, telephones take sound vibrations and turn them into electrical vibrations of the same shape before they are transmitted over traditional telephone lines.

Digital Transmission: In this transmission, information is characterized by discrete states. A light bulb, for example, is on or off. A digital clock represents the time in one-minute intervals and does not change its numbers again until the next minute. So the transmission signal is not continuous but discrete. So the digital transmission is quite different from the analog one. The signal in digital transmission is much simpler. It's a series of 0s and 1s. So 1 (or On) is represented by peak of the signal and 0 (or Off) is represented by bottom of the signal.

5.2 COMMUNICATION TERMINOLOGY

The section below briefly summarizes the terminology used in communications using computers. It talks about bandwidth and electromagnetic spectrum.

1. **E-M Spectrum:** The electromagnetic spectrum is the range of all possible frequencies of electromagnetic radiation. The E-M spectrum of an object has a different meaning, and is instead the characteristic distribution of E-M radiation emitted or absorbed by the particular object. The E-M spectrum extends from the low frequencies used for modem radio communication to gamma radiation at the short wavelength (high frequency)end, covering wavelengths from thousands of kilometers down to a fraction of the size of an atom.

   Although the electromagnetic spectrum represents an enormous range of frequencies, not all the frequencies are suitable to purposes of human communications. Fig. 5.4 below shows the E-M Spectrum of various communication and network devices.

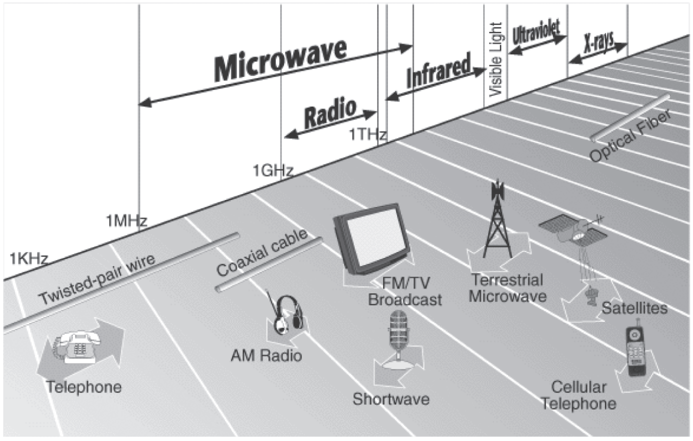

Fig. 5.4: E-M Spectrum of Communication Devices

2. **Bandwidth:** It is the range of frequencies that make up a signal. There are three major classes of bandwidth that we refer to in telecommunications networks: narrowband, wideband, and broadband.

   A. **Narrowband**

   It can accommodate up to 64Kbps, which is also known as the DS-0 (Digital Signal level 0) channel. This is the fundamental increment on which digital networks were built. Initially, this metric of 64Kbps was derived based on our understanding of what it would take to carry voice in a digital manner through the network. If we combine these 64Kbps channels together, we can achieve wideband transmission rates.

   B. **Wideband**

   Wideband is a transmission medium or channel that has a wider bandwidth than the voice channel i. e., more than 64Kbps. This term is usually contrasted with narrowband.

   C. **Broadband**

   The most modern bandwidth used has broadband capacities. Broadband can be defined in different ways, depending on what part of the industry you are talking about. Technically speaking, it has been defined as being anything over 2Mbps. The term broadband refers to any type of transmission technique that carries several data channels over a common wire. For example, in home networking, broadband constitutes any form of high-speed Internet access using this transmission technique.

3. **Transfer Rate :** It is the amount of digital data that is moved from one place to another in a given time. Usually in second's time. The data transfer rate can be viewed as the speed of travel of a given amount of data from one place to another.

5.3 TRANSMISSION MEDIA

The transmission media that are used to convey information can be classified as guided or unguided. **Guided media** provides a physical path between transmitter and receiver.

Guided media include –

1. **Twisted Pair:** A twisted pair of wires consists of two insulated copper wires, typically about 1 mm thickness. The wires are twisted together in a helical shape. These are commonly used in local telephone communication.

2. **Coaxial Cable:** Coaxial cable consists of a stiff copper wire as the core, surrounded by an insulating material. Higher data rates over longer distance can be achieved with coaxial cable.

3. **Optical Fiber:** This media is superior in data handling and for security purposes. Each fiber has an inner core of glass or plastic that conducts light. It's a flexible transparent fiber made using silica glass and has been drawn very thin. Optical fiber can be used as a medium for telecommunication and computer networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables.

Unguided media employs an antenna for transmitting through air, vacuum, or water. Unguided media includes –

1. **Microwave Transmission:** In microwave transmission the waves travel in straight lines. It gives a much higher signal noise ratio, but the transmitting and receiving antennas must be accurately aligned with each other.

2. **Radio Waves:** Radio waves can be broadcasted in all directions from the source i.e., Omni-directional so that the transmitter and receiver do not have to be carefully aligned physically.

3. **Infrared Waves:** Infrared waves are widely used for short-range communication. The remote controls used on television, VCRs and stereos use infrared communication.

4. **Communication Satellite:** In satellite communication, signal transferring between the sender and receiver is done with the help of satellite. In this process, the signal which is basically a beam of modulated microwaves is sent towards the satellite. Then the satellite amplifies the signal and sends it back to the receiver's antenna present on the earth's surface. So, all the signal transferring is happening in space. Thus this type of communication is known as space communication.

5. **Bluetooth:** Bluetooth is a WPAN technology. Accordingly its radio characteristics include low power, short range, and medium transmission speed. It effectively exchanges data over short range. Today the Bluetooth market focuses on professional and field workers, who need to travel off-site but still require access to corporate communication and information.

6. **Wi-Fi:** Wi-Fi is a Local Area Network (LAN) - you will know more about LAN, later in this lesson. Wi-Fi depends on a high energy intake to offer a 100 meter range and much higher transmission rate. This speed makes Wi-Fi much more faster Bluetooth and similar to a high speed modem. For large file transfer and quick Internet access, Wi-Fi outperforms Bluetooth.

Notes

5.4 COMPUTER NETWORK

A computer network is a group of computers which are interconnected to exchange and share information. People can transfer or receive information at minimum cost and time, using computer networks. The Internet is a computer network that millions of people use every day. Other shared resources can include a printer or a file server. The Internet itself can be considered as a computer network.

Data or information available at a central computer can be easily shared, updated and accessed by all the other users connected to the central computer. Computer networks from ISPs to Wi-Fi and cellular networks are a key part of the information economy. These networks are the foundation for the Web. The connection between computers can be done via cabling, most commonly the Ethernet cable, or wirelessly through radio waves. Connected computers can share resources, like access to the Internet, printers, file servers, and others. A network is a multipurpose connection, which allows a single computer to do more.

5.4.1 Network devices

Computer network devices are also known as communication devices and they constitute a data communication network. These devices are routers, switches, hubs, LAN cards, gateway, modems, hardware firewall, Channel Service Unit (CSU)/Data Service Unit (DSU), ISDN terminals and transceivers. In an Ethernet or WAN network, the data communication cannot be performed without these devices. Being an IT professional or a network administrator, you must have good understanding of these devices. Some of these devices and their functionalities are described below:

1. **Modem**: A modem is a communication device that is used to provide the connectivity with the internet. Modem works in two ways i.e. modulation and demodulation. It converts the digital data into the analog and analog to digital. Figure below shows the position of modem when two computers are interacting with each other.

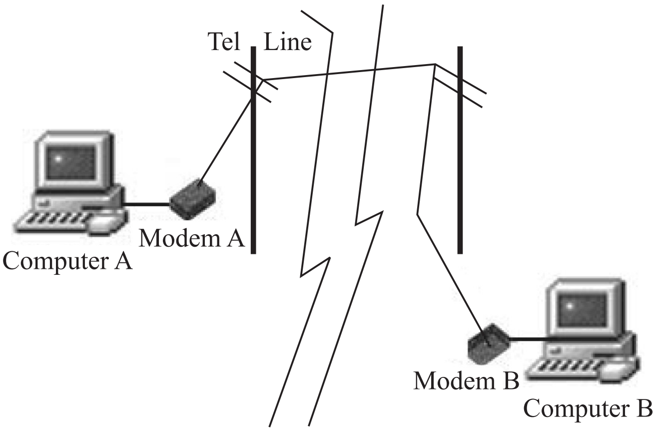

Fig. 5.5: Usage of Modem

Notes

2. **RJ45 Connector**: RJ45 is a type of connector commonly used for Ethernet networking. It looks similar to a telephone jack, but is slightly wider. Since Ethernet cable have a RJ45 connector on each end, Ethernet cables are sometimes also called RJ45 cables. The 'RJ' in RJ45 stands for 'registered jack' since it is a standardized network interface. The '45' simply refers to the number of the interface standard.

3. **Ethernet card:** An Ethernet card is one kind of network adapter. These adapters support the Ethernet standard for high-speed network connections via cables. Ethernet cards are sometimes known as network interface cards (NICs). Ethernet is the most commonly used local network technology deployed with transmission speeds heading upwards into the gigabits range. It is the most widely installed local area network (LAN) technology. Ethernet is a link layer protocol in the TCP/IP stack, describing how networked devices can format data for transmission to other network devices on the same network segment, and how to put that data out on the network connection.

4. **Routers:** Routers are networking devices used to extend or segment networks by forwarding packets from one logical network to another. A router is a device that forwards data packets along networks. A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP's network. Routers are located at gateways, the places where two or more networks connect. Routers are most often used in large Internet works that use the TCP/IP protocol suite and for connecting TCP/IP hosts and local area networks (LANs) to the Internet using dedicated leased lines.

5. **Hub:**A hub is the most basic networking device that connects multiple computers or other network devices together. Unlike a network switch or router, a network hub has no routing tables or intelligence on where to send information and broadcasts all network data across each connection. Most hubs can detect basic network errors such as collisions, but having all information broadcast to multiple ports can be a security risk and cause bottlenecks. Hubs connect computer together in a star topology network. Due to their design, they increase the chances for collision. Hubs operate in the physical layer of the ISO model and have no intelligence. In the past network hubs were popular because they were cheaper than a switch and router. Today, switches do not cost much more than a hub, and are much better solution for any network.

Hubs can be of two types: Active hubs: These devices not only function as regenerator, but also provide multiple ports for several computers to connect in a network. Passive hubs: These devices only provide multiple ports for several computers to connect to a network.

6. **Switches:** Switches are a special type of hub that offer an additional layer of intelligence to basic physical layer repeater hubs. A **switch** does essentially what a hub does, but more efficiently. By paying attention to the traffic that comes across it, it can "learn" where particular addresses are. A switch must be able to read the MAC address of each frame it receives. This information allows switches to repeat incoming data frames only to the addressed computer. Switches learn the location of the devices that they are connected to almost instantaneously. The net result is that most network traffic only goes where it needs to rather than to every port. On busy networks, this can make the network much faster.

7. **Gateways:** A network gateway is an internetworking system capable of joining together two networks that use different base protocols. A network gateway can be implemented completely in software, completely in hardware, or as a combination of both. So gateway is a device used to connect networks using different protocols. Gateways operate at the network layer of the OSI model. In order to communicate with a host of other networks, an IP host must be configured with a route to the destination network.

   Gateways are also called as protocol converters and translators.

8. **Bridges**:A bridge is a device that separates two or more network segments within one logical network (e.g. a single IP-subnet).A bridge is usually placed between two separate groups of computers that talk with each other, but not that much with the computers in the other group. The job of the bridge is to examine the destination of the data packets one at a time and decide whether or not to pass the packets to the other side of the Ethernet segment. The result is a faster, quieter network with fewer collisions. A bridge is used to join two network segments together; it allows computers on either segment to access resources on the other. They can also be used to divide large networks into smaller segments.

5.4.2 Types of Networks

A computer network, often simply referred to as a network, is a collection of computers and devices interconnected by communications channels that facilitate communications and allows sharing of resources and information among interconnected devices. Networks may be classified according to a wide variety of characteristics such as medium used to transport the data, communications protocol used, scale, topology, organizational scope, etc. Computer networks are now rapidly used by the all levels of society, like government bodies, schools,

colleges and private sector etc. There are many types of computer networks, some of the important ones are described below:

1. **Local Area Network (LAN)** : Local Area Network is confined to small geographical area, like in a building or group of buildings. Data transfer rate of LAN is very high even faster than data transmitted through telephone lines. It's a group of computers all belonging to the same organization, and are linked within a small geographic area using a network. At security purpose level, it is not trust worthy because, for example, an employee of an organization can change the important data of the organization. Due to its small size, it is possible for one person to administrate a Local Area Network. The defining characteristics of LANs, in contrast to Wide Area Networks (WANs), include their usually higher data-transfer rates, smaller geographic area, and lack of need for leased telecommunication lines.

   LANs are typically used for single site where people need to share resources among themselves but not with the rest of the outside world. Think of an office building where everybody should be able to access files on a central server or be able to print a document to one or more central printers. Those tasks should be easy for everybody working in the same office, but you would not want somebody just walking outside to be able to send a document to the printer from their cell phone. If a local area network, or LAN, is entirely wireless, it is referred to as a Wireless Local Area Network, or WLAN.

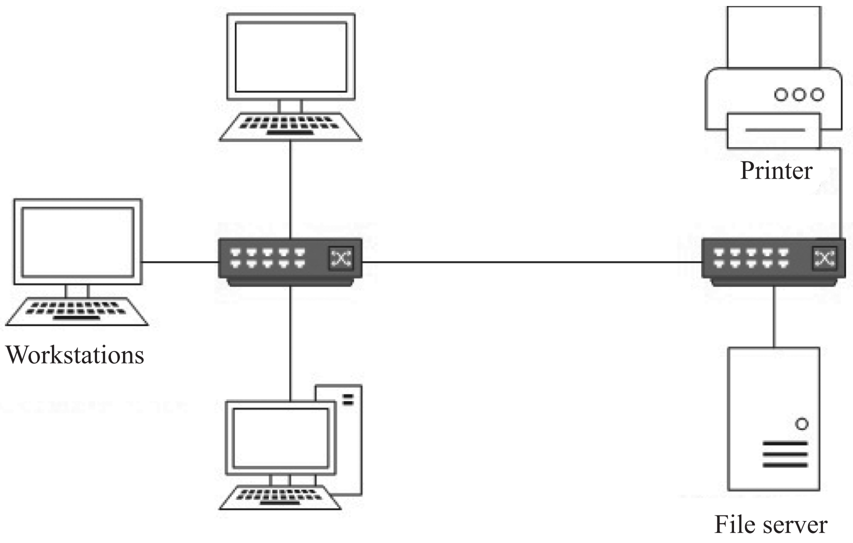

Fig. 5.6: Local Area Network (LAN)

2. **Metropolitan Area Network (MAN)** : Metropolitan Area Network or MAN is basically spread throughout a city, college campus or a small region. MANs are larger than LANs, and it enables its users to share information throughout

the city. It is commonly used by schools, campuses, hospitals, large universities, large companies etc.

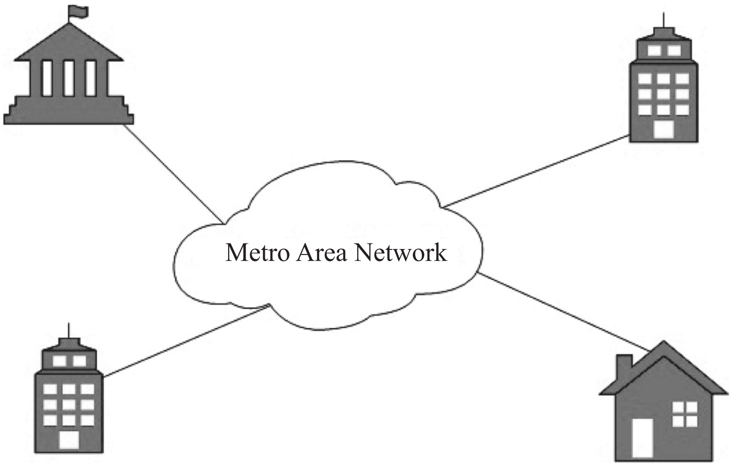

Fig. 5.7: Metropolitan Area Network (MAN)

3. **Wide Area Network (WAN)** : Wide Area Network covers comparatively large geographic area than LAN and MAN, for example an entire country. It uses public network telephone lines and lease lines. This type of network can even be spread over the world.WAN provides network to the LAN and MAN. This is very speedy and expensive. Wide Area Networks use optic fiber as their communication medium. Internet is best known example of public WAN.

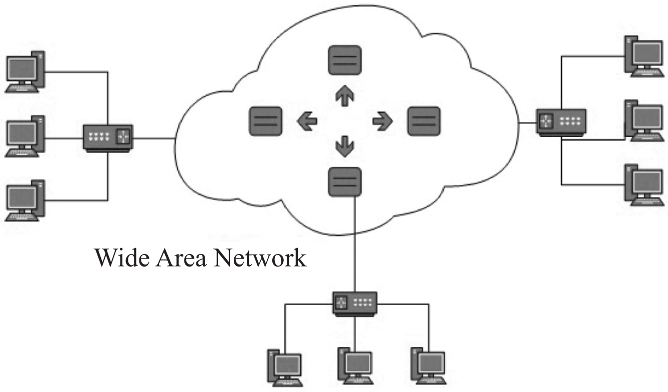

Fig. 5.8: Wide Area Network (WAN)

5.5 NETWORK TOPOLOGY

Network topology is the schematic description of a network arrangement, connecting various nodes (sender and receiver) through lines of connection. Topology is the schematic diagram showing how the networks are connected physically and logically. Physical topology is the physical layout of nodes,

workstations and cables in the network; while logical topology is the way information flows between different components. So network topology is the arrangement of the various elements of a computer network. Details of network topologies are given below and are represented in Fig. 5.9:

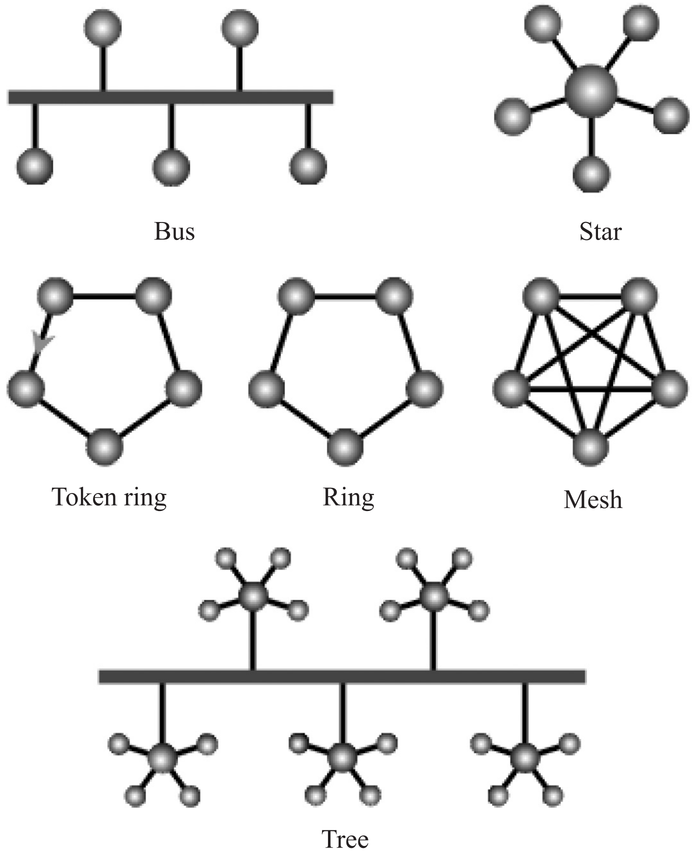

Fig. 5.9: Network Topology

1. **Bus Topology:** In this type of topology all computers are connected by a single length of cable with a terminator at each end. The bus topology is the simplest and most widely used local area network design. Only one computer at a time can send a message. It transmits data only in one direction and every device is connected to a single cable. So it affects the speed of the network. It is cost effective and requires least amount of cable compared to other topologies. It is normally used in smaller networks and is very easy to understand. But it is slower and if the main cable fails, the entire network fails.

2. **Star Topology:** The star network is frequently used to connect one or more small computers or peripheral devices to a large host computer or CPU. Each computer on a star network communicates with a central hub that re-sends the message either to all the computers or only to the destination computer.

Every node has a dedicated connection to the central hub. It is fast with few nodes and low network traffic. It is easy to troubleshoot and easy to setup. But cost of installation is high and is expensive to use as well. If the host computer fails, the entire network gets affected.

3. **Token Ring:** A token ring network is a Local Area Network (LAN) in which all computers are connected in a ring or star topology and a bit- or token passing scheme is used in order to prevent the collision of data between two computers that want to send messages at the same time. The token ring protocol was developed by IBM. The access method used involves token passing. In token ring, the computers are connected so that the signal travels around the network from one computer to another in a logical ring.

4. **Ring Topology:** In this type of topology the workstations are connected in a circle using cable segments. In this layer each node is physically connected to only two other nodes i.e., adjacent pairs of workstations are directly connected. Ring topology can function without server. The ring topology may prove optimum when system requirements are modest and workstations are at scattered points.

5. **Mesh Topology:** It is a type of network setup where each of the computers and network devices are interconnected with one another. A mesh topology is most often used in large backbone networks in which failure of a single switch or router can result in a large portion of a network going down. A mesh network topology is a decentralized design in which each node on the network connects to at least two other nodes. Mesh networks can use a full mesh topology or a partial mesh topology. In a full mesh topology, each network node is connected to all the other nodes in the network. In a partial mesh topology, at least one node connects directly to every other node while others may only connect to those nodes they exchange data with on a frequent basis.

6. **Tree Topology:** The tree topology, also known as **Hierarchical topology** uses two or more star networks connected together. It could also employ a combination of bus and star topologies. This topology divides the network into multiple levels of network. It has a root node, intermediate node, and ultimate nodes. The tree network topology is ideal when the workstations are located in groups, with each group occupying a relatively small physical region. An example is a university campus in which each building has its own star network, and all the central computers are linked in a campus-wide system. It is easy to add or remove workstations from each star network. Entire star networks can be added to, or removed from, the bus.

INTEXT QUESTIONS 5.1

I. Choose the appropriate answer.

1. What are the basic elements of communication system?
   a. Conductor b. Transmitter
   c. Channel & Receiver d. b & c
2. The slowest transmission speed are those of ....
   a. Twisted pair wire b. coaxial cable
   c. Fiber optic cable d. Microwaves
3. A network that can function without server is a ....
   a. Ring network b. Star network
   c. Bus network d. All of the above

II. State whether the following statements are true or false:

1. WAN comparatively covers small geographic area.
2. Tree topology is also known as hierarchical topology.

5.6 NETWORK PROTOCOLS

A network protocol defines rules and conventions for communication between network devices. Network protocols include mechanisms for devices to identify and make connection with each other.

There are several protocols which are given below –

1. **FTP :** The File Transfer Protocol (FTP) is the most widely used protocol for file transfer over the network. FTP uses TCP/IP for communication.
2. **PPP :** PPP means Point to Point Protocol. It is a much more developed protocol than SLIP, in so far as it transfers additional data, better suited to data transmission over the internet.
3. **TCP/IP :** TCP(Transmission Control Protocol) and IP (Internet Protocol) are two different procedures that are often linked together. The linking of several protocols is common since the functions of different protocols can be complementary so that together they carry out some complete task.

4. **HTTP :** Hypertext is well organized documentation system which uses hyperlinks to link the pages in the text documents. HTTP (i.e. Hypertext Transfer Protocol) works on client server model.

5. **HTTPS :** Hypertext Transfer Protocol Secure is a communication protocol for secure communication over a computer network.

6. **SLIP :** Serial Line Internet Protocol is the result of the integration of modern protocols prior to the suit of TCP/IP protocols. It is a simple Internet link protocol conducting neither address or error control, this is the reason that it is quickly becoming obsolete in comparison to PPP.

You will learn more detail about protocols in the next lesson.

5.7 MALWARES

Malware is short for malicious software and used as a single term to refer to virus, spyware, worms etc. Some examples of malware risks are:

1. **Virus :** Virus is a program written to enter in your computer and damage/ alter your files/data. A virus might corrupt or delete data on your computer. Virus can also replicate themselves.

2. **Spam :** Spamming is a method of flooding the Internet with copies of the same message. Most spams are commercial advertisements which are sent as unwanted emails to users. Spams are also known as electronic junk mails.

3. **Hacking:** Computer hacking is the practice of modifying computer hardware and software to accomplish goal outside of the creator's original purpose. In computer security, a hacker is someone who seeks and exploits weaknesses in a computer system or computer network. Hackers may be motivated by a multitude of reason such as profit, challenge, enjoyment or to evaluate those weaknesses to assist in removing them.

5.8 SECURITY CONCEPT

Network devices – such as routers, firewalls, gateways, switches hubs and so on, create the infrastructure of local area networks and the Internet. Securing such devices is fundamental to protecting the environment and outgoing/incoming communications. Some security methods are –

1. **Firewall :** A firewall is a hardware device or software application installed on the borderline of secured network to examine and control incoming and outgoing network communications. Firewall provides protection from outside attacks.

Notes

2. **Antivirus :** The word 'antivirus' refers to a group of features that are designed to prevent unwanted and potentially malicious files from entering your network. These features all work in different ways, which include checking for a file, size, name, or type or for the presence of a virus or grayware signature.

Cyber Ethics and IT : Cyber Ethics is the philosophic study of ethics pertaining to computers, encompassing user behaviour and what computers are programmed to do, and how this affects individuals and society.

INTEXT QUESTIONS 5.2

Fill in the blanks.

1. .... protocol is most widely used protocol for file transfer over the netwrok.
2. .... is a communicaiton protocol for secure communication over a computer network.
3. .... is a program written to enter in your computer and damage/alter your file/data.

WHAT YOU HAVE LEARNT

- The basic elements of data communication system i.e., sender, receiver, channel.
- Three types of transmission modes are simplex, half duplex and full duplex.
- Bandwidth is the range of frequencies that make up a signal.
- Computer network is a group of computers which are interconnected to exchange and share information.
- Hub is a common connection point in a network.
- Modem converts digital data into analog and analog to digital.
- Bridge is a device that separates two or more network segments within one logical network.
- Network protocol defines rules and conventions for communication between network devices.
- FTP, PPP, TCP/IP, HTTP, HTTPS, SLIP are some of the network protocols.
- Firewall provides protection from outside attacks.

TERMINAL EXERCISE

1. Where can Bluetooth device be useful?
2. What is RJ45 connector?
3. What is Ethernet and how does it work?
4. What do you mean by network topology? Write the names of different types of network topologies.
5. What are the different types of networks? Write in detail.
6. Write a short note on TCP/IP, PPP, FTP protocols.
7. Write a short note on virus, spam, hacking.
8. What is antivirus software?

ANSWERS TO INTEXT QUESTIONS

5.1

I. 1. d   2. a   3. a

II. 1. False   2. True

5.2

1. File transfer
2. Hypertext Transfer Protocol Secure
3. Virus

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6

COMMUNICATIONS ON INTERNET

In the previous lesson you have learnt about data communication and networking concept. Communication means transfer of data. Undoubtedly Internet is the fastest means of communication today and that is why it is called the "Information Superhighway". It has revolutionized almost every facet of our lives. Whether we have to exchange messages, share pictures and videos, find information on any topic, debate in a group, or view live lectures, Internet is there to provide all these services to you at the click of the button. It has grown and evolved over the years and changed the way we communicate across the globe today. Internet has shrunk the world into a global village. Desktop computers, mainframes, cell phones, security alarms, video game consoles, GPS units, etc., are all connected to the net.

In this lesson, you will learn about internet, its related terminologies and also about some common ways of communication on Internet like email, instant messaging, newsgroup, blogging, social networking etc.

OBJECTIVES

After reading this lesson, you will be able to :

- define Internet;
- describe Internet related terminologies;
- list Internet protocols (TCP/IP, FTP, HTTP);
- use Internet;
- assess various Internet services like;
  - email;

- Instant Messaging and Chat Rooms;
- Blogs;
- Newsgroups;
- Video Conferencing;
- Social Networking;

- explain Cookies and Cloud Computing;

6.1 INTERNET

Internet (Inter-Network) or simply 'Net' is a vast communication network which connects thousands and millions of computers across the globe. It is also called network of networks because it is made up of thousands of smaller networks that can exchange information with each other. The users connected to Internet can share resources and communicate with each other. Internet offers many methods of connecting with people like emailing, chatting, blogging, social networking etc. Internet is an information hub. We can find information on almost any topic in the world. Any user can create content, offer services and sell products on the internet without requiring permission from any central authority. That is why we have wide range of applications and services to avail on the net.

Although no single person or organization actually runs the internet, yet tens of thousands of interconnected networks run by service providers, individual companies, universities, government etc. together run the Internet. Hence we say that 'No one but still everyone runs the Internet'. In fact, today, the net has grown into a spectacular combination of private sector, government sector and entrepreneurial broadcasters.

To connect to Internet, we need the following:

(i) A web browser installed on our computer

(ii) A modem

(iii) A telephone connection

(iv) A connection from an Internet Service Provider(ISP) like Airtel, MTNL etc.

Internet uses certain rules called **protocols** which allow sharing of resources among various users on the network. You will learn about these protocols later in this lesson.

6.1.1 History of Internet

The Department of Defence in USA created a small network called **ARPANET** (**Advanced Research Projects Agency Network**) to protect government

communication systems in the event of a military strike. Using standard protocols, this network connected only contractors, military personals and university researchers who were involved in the project, so that they could communicate and share data with each other. The popularity of ARPANET spread among researchers and soon **National Science Foundation** launched **NSFNet** that linked several high speed computers. This later came out to be known as **Internet**. By late 1980s, thousands of cooperating networks were part of Internet. Present day Internet is now a platform for all types of resources. In fact, it continues to grow as an informational and communication resource with each passing day. It provides personal, economic, educational, and political resources to each connected user across the globe. It has truly become a communication highway for millions of users.

6.2 INTERNET TERMINOLOGIES

You will come across various terminologies associated with communications on Internet during the course of this lesson. Let us first understand these terminologies.

Webpage

The document that can be viewed in the web browser is known as the web page.

Website

The collection of web pages interlinked with each other through hyperlinks is known as website. The first page of a website is known as the **home page**.

World Wide Web (WWW)

The World Wide Web(WWW) or simply the 'web' is a system of Internet servers that support documents formatted using HTML. These documents or web pages may contain links to other documents (hyperlinks), text, graphics, audio or video files. So a user can search for the desired data or information by navigating from one web page to another.

Web Browser

A web browser is a free software application that is used to view web pages, graphics and almost any other online content. It is specifically designed to convert HTML and XML into readable document. A web browser helps us to navigate through the World Wide Web. Some of the common web browsers are Internet Explorer, Firefox, Google Chrome, Netscape Navigator and Safari.

Web Server

It is the server on the World Wide Web that responds to the request made by the web browsers.

URL

Every web page or file has a unique address assigned to it. This special format of the address is known as **Uniform Resource Locator** or URL. Hence a URL specifies the unique address assigned to each web resource (viz., web page, video, image, song etc.). The general format of URL is given below:

type:// address/path

In the above format

type – specifies the type of server or protocol

address – specifies the name / address of the server on the Internet

path – specifies the location of file on the server

For example, consider the following URL

www.airindia.in/travel-info.htm

In the above example http identifies both protocol and server followed by a colon (:) and two forward slashes (//). www.airindia.in is the name of the server and travel-info.htm is the name of the HTML file on the server. This type of character based naming system is known as **Domain Name System(DNS)**.

Here, it should be mentioned that names of the servers commonly begin with 'www' for World Wide Web. Types of domain names are given in the table below:

Domain Name	Purpose
.com	For commercial firms/companies/organizations
.edu	For educational organizations
.gov	For government organizations
.mil	For military bodies/ regiments etc.
.net	For network bodies/organizations
.org	For non- profit organizations
.biz	For business firms/bodies/organizations

Notes

In addition to the above table, sometimes, a two letter abbreviation indicating the country name is also used. For example, in the domain name www.yahoo.co.in, 'in' indicates the country India.

A URL and the IP addresses help us to name, find and bookmark specific pages and files for our web browsers.

IP Address

As mentioned before, every web page has a specific address. Similarly every computer on the network also has a unique address. This is called the IP address where **IP** stands for **Internet Protocol**.' Any computer's IP address is a four-part or eight- part electronic serial number with each part separated by dots (.) or colons(:). For example '212.30.0.220' is an IP address. Any device, may it be laptop, computer or smartphone that accesses the net, is assigned at least one IP address for tracking purposes.

HTML

HTML stands for **Hyper Text Markup Language**. Here, 'hypertext' refers to the hyperlinks that an HTML page may contain and the 'markup language' refers to the way tags are used to define the page layout and the elements within the page and also to make the document interactive through hyperlinks. Hence it defines how web pages are formatted and displayed in the web browser. In simple terms, HTML specifies how to display text, pictures, images, videos or even hyperlinks in the browser. Please note that HTML is neither a word processing application nor a **Desk Top Publishing** (DTP) software nor a programming language. It is just a markup language that specifies the web page layout and hyperlinks through special layout commands called **tags**. So we have separate tags for headings, titles, fonts, images, tables, hyperlinks etc.

The general structure of an HTML document is given below:

```
<HTML>
        <HEAD>
        ……
        </HEAD>
        <BODY>
        ….
        </BODY>
</HTML>
```

You will learn HTML in detail in the web designing lesson.

XML

XML (**Extensible Markup Language**) is the language that is used to display the content of a web page in a structured manner. It defines a set of rules for encoding documents in a format which is both human-readable and machine-readable and hence can be read by any XML compatible application. XML is basically a mechanism for defining tags and structural relationships between these tags. It focusses on cataloguing and databasing the text content of the web page. This flexible language is used to describe data, to create information formats and to electronically share structured data using Internet.

XML files contain tags and text similar to HTML. But unlike HTML, XML is not a markup language. Instead it is a 'meta-language' which can be used to create markup languages for specific applications. It allows us to create a database of information without having an actual database. HTML defines how elements are displayed and printed while XML assigns meaning to the elements. Also, HTML uses predefined tags but XML requires the developer of the content to define most of the tags. However, XML can be used with HTML pages also.

For example, in a web page, XML may describe the items that have to be accessed when the web page loads and HTML defines the layout of the items to be displayed. Just like database records, any data item such as 'roll no', 'name','date of birth' can be specified. Because of this provision of common method of identifying the data and separating the data from presentation, XML has become the standard format for electronic interchange and web services.

ISP

ISP or Internet Service Provider is either a private company or a government agency that offers varying services like viewing web pages, emailing, hosting and publishing web pages, blogging etc. Some of the examples of ISPs are MTNL, Airtel, TataDocomo etc. Generally these ISPs offer their services at various speed connections for a monthly fee.

Now-a-days we are also able to get wireless services from various **Wireless Internet Service Providers** (WISPs) that cater to laptop and smartphone users who travel on a regular basis.

6.3 INTERNET PROTOCOLS

You have learnt that, protocol is the set of rules that are followed while communicating on any network. No activity, may it be sending messages or sharing files, can be done on any network without using protocols. Some of

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the common protocols used while communicating on Internet are: TCP/IP, FTP, HTTP etc.

Let us discuss these in details.

6.3.1 TCP/IP (Transmission Control Protocol/Internet Protocol)

TCP/IP protocol is the basic protocol of the Internet. It is not a single protocol but a suite of protocols that define the set of commands that specify the sender, receiver and the data that is being transmitted. For any communication, we need two things- the message to be transmitted and means to transmit it. The TCP part of the protocol handles the message to be transmitted. It breaks the message into small units called packets and then transmits them over network. The packets when received are again reassembled back by TCP of the receiver. It also retransmits any part of data that was not received by the destination computer. The IP part of the protocol is concerned with the transmission of data to the right destination. It assigns a unique IP address to each and every recipient of the network. By this, it makes sure that the data is transmitted at the correct destination.

TCP/IP can also be used as a communication protocol over a private network. When our computer is connected to the Internet, it is provided with a copy of the TCP/IP program in order to allow communication with other computers on the network. Nearly all computers today support TCP/IP. Since TCP/IP has become the foundation of Internet, so this software is built into all major operating systems viz. Windows, Unix and Mac OS.

6.3.2 FTP (File Transfer Protocol)

FTP defines the set of rules to transfer any type of file on a TCP/IP based network. It is most commonly used to download a file from a server or to upload a file to a serverusing Internet. FTP divides the file into multiple segments and assigns a reference number to each segment. These segments are then transmitted and reassembled at the destination computer so that the exact copy of the original file is received. FTP also performs automatic error detection and correction during the file transfers. There are hundreds and thousands of FTP files over the Internet. Files stored on an FTP server can be accessed using FTP client such as web browser, FTP software program or using command line interface.

6.3.3 HTTP (Hyper Text Transfer Protocol)

HTTP is the set of rules that are used to transfer hypertext on World Wide Web. Hypertext can be in the form of text, graphic, sound or video. HTTP is the

language of web pages and consists of two forms- (i) the set of requests from browsers to servers and (ii) the set of responses from server to the browsers at the user end. It has various built in request methods which allow the users to read, store or remove a web page, to connect two or more web pages or even remove the existing connection between two web pages.

HTTP defines how messages are formatted and transmitted. It also defines the actions taken by the web servers and browsers in response to various commands. For example, when we enter the URL of a website in the address bar of the browser, an HTTP command is sent to the web server directing it to find and transmit the requested web page in the browser window. As soon as the user opens any of the browser applications, HTTP protocol is automatically put to action.

> *__https__ stands for __H__yper __T__ext __T__ransfer __P__rotocol __S__ecured'. In this protocol, a special layer of encryption is added to hide user's personal information and passwords. This is specifically used by ecommerce sites to secure online transactions.*

6.4 WORKING OF INTERNET

Each of the computers connected on the network is called host. These computers are connected to each other using various communication media like telephone lines, fibre optic cables, microwaves and satellites. Internet allows many computers to connect and communicate with each other using standard set of rules called protocols. The most important protocol governing the Internet is TCP/IP.

As mentioned before, there is no particular organization that controls the Internet. A personal computer can be linked to the Internet using a modem. The modem communicates with the server of an Internet Service Provider(ISP). As mentioned before, ISP is the company that provides internet connections to the users and each user has to get a connection from any of the ISPs. In case of LANs that are operational in small organizations or universities etc., the server of each of these LANs are connected to the server of ISP using high speed telephone lines. The computer when connected to the ISP server, makes its connection to the larger ISP (Regional ISP) which are further connected to other larger ISPs (World ISP) using fibre optics or satellites. This is how each computer gets connected to Internet. Figure 6.1 below depicts the working of Internet.

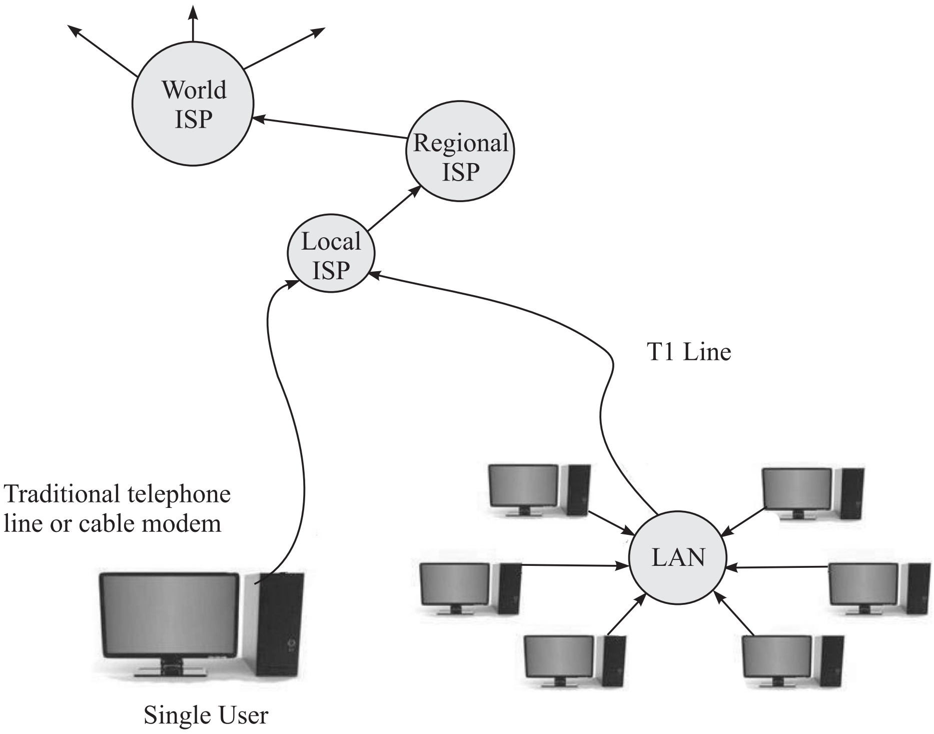

Fig. 6.1: Working of Internet

Let us now have a look at the sequence of events that leads to transmission of data from one computer to another on Internet.

(i) Each computer on the network has a unique IP address assigned to it. The source computer breaks the data to be transmitted into small packets. Each packet has a serial number and an IP address of the receiving computer on it.

(ii) All these packets are then sent to the address of the destination computer. The packets pass through various computers on the network until they reach their destination computer.

(iii) Since the destination computer receives the packets in random order, the TCP protocol reassembles the packets according to their serial number. If any packet is lost or garbled during transmission, it is demanded again. The process continues till the original data is obtained.

INTEXT QUESTIONS 6.1

Fill in the blanks:

1. Internet is ....

2. To connect to the internet you need ...., ..., ..., ...
3. ARPANET stands for ....
4. The rules to communicate on Internet are called ....
5. The first page of a website is known as ....
6. .... helps us to navigate through the world wide web.

6.5 INTERNET SERVICES

With the advancement of technology, the range and quality of services available on net has also increased. These wide range of services help us to communicate and share data. Let us discuss some of the commonly used services available on the net.

6.5.1 Email

Email or Electronic mail refers to the messages sent electronically via Internet. These messages travel through multiple channels till they reach their destination with definite address. In today's technological era, Emails have become an indispensable part of communication. You will learn Email in detail in the next lesson.

6.5.2 Instant Messaging and Chat Rooms

Instant Messaging (IM) is another Internet service that allows us to communicate with the people instantaneously. This communication is generally through text based messaging but now a days voice chat is also increasingly becoming popular.

To avail this service, download the messenger program on the browser. Some of the messenger services available on the net are Skype, Yahoo Messenger, Hike Messenger, Google Talk etc. In most cases the sender and the receiver communicating through IM are known to each other. As the messenger opens, a list of people who have their accounts in that messenger service is displayed. The IM system alerts us when somebody on our private chat list is online or has sent us a message. We may respond to the message and hence start the chat by typing messages in the **Chat window** that appears on the screens of both sender and receiver (Fig. 6.2). With the advancements in technology, most of the instant messaging service providers allow us to send and share links, videos, images, audio files and many more.

In an Instant Messaging service, two people are sending and receiving messages through a Chat window. On the contrary, a chat room, is an online web service in which two or more users can send messages to each other in real time. Although a chat room generally consists of people with common interest, but

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the participants might be either known to each other or might be anonymous. The participants can engage in text based, voice based or video based live discussions with one another. Text from all users is instantly displayed in the chat room's conversation log or **chat window**. This service also gives the option of chatting privately with a particular user but generally these individual chat sessions are for customer service, where each individual customer's query is answered privately. Chat rooms are also utilized by employees of various organizations to communicate with each other from multiple locations. Some of the popular chat room service providers are Openchat, Teenchat, Paltalk etc. Even the Instant messaging services can also be used for chatting through chat rooms. Also almost all the IM and chat service providers give us the options for voice chat and video chat. So we have the option to exchange voice messages and live images as well.

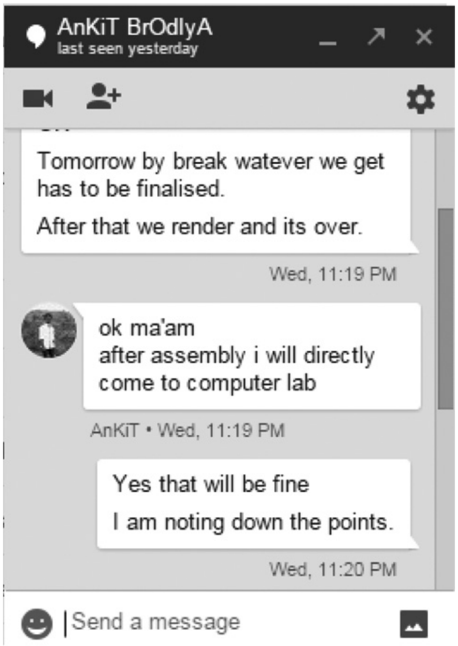

Fig. 6.2: Chat Window

6.5.3 Newsgroups

A newsgroup is just like a public forum where multiple users are continuously exchanging information about a particular topic. The messages are posted on a bulletin board of the newsgroup and any member can read and respond to them. To view and post messages in the news group, firstly, we need a news reader application that runs on our computer and connects us to a news server on the internet. Unlike chat rooms, the communication in a newsgroup is not instant. People may read and respond to the messages that are posted on bulletin boards as per their convenience.

In a single newsgroup several active discussions may be in progress between hundreds and thousands of people. One can join a newsgroup at any time to become part of this huge conversation. The newsgroups are organized into various categories as shown in the table below.

Category	Subjects
Alt	Varied
news	Usenet technical issues
Soc	Social issues
comp	Computers and technology
misc	Miscellaneous
Rec	Recreation (sports, adventure etc.)
talk	Controversial and sensitive topics
alt.binaries	Images and videos
Biz	Business and advertising

The newsgroups are read from right to left. For example rec.trek.himalyas means 'Trekking in Himalyas' is the topic in the 'recreation' category. Some of the websites offering newsgroup services are giganews.com, supernews.com etc.

6.5.4 Blogs

The word blog was coined by Peter Merholz in 1999 and it comes from the word "Web Log." The literal meaning of a blog is a website that contains an online personal journal with his/her comments, reflections and also hyperlinks provided by the author. So, using this internet service, the users are able to post journal entries on a web page and thus share their thoughts and ideas. This process of authoring or editing a blog is called **blogging**. Each individual article that is posted is known as a **blog post**. The blogs which are created and edited by multiple users are known as **Multi Author Blogs(MABs)**.

A typical blog is the combination of text, images, audio, video and even links to other blogs. Anybody who knows how to create and publish a webpage can easily publish their own blog by typing the text and clicking "Publish" button. We can say that a blog is like a website on which personal feelings and experiences can be shared with thousands of people around the world. It is sort of an online writer's column. That is the reason now-a-days blogging is also seen as a form of social networking service. Amateurs and professional writers

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publish their blogs on various topics viz. their hobbies, opinions on political matters, their views on celebrities, technical tips on using various applications etc. Blogs can even be used for advertising and promotions of a product, individual or a company.

The type of blogging in which only short messages are posted is known as **microblogging.** The commonly used website for microblogging is Twitter created in 2006 by Jack Dorsey. Using Twitter, the user can send and receive maximum of 140 characters in a text message. That is why Twitter is also known as **'SMS of the Internet'**. These messages on Twitter are known as **tweets**. Registered users can read and post the tweets while unregistered users can only read the tweets posted by others.

6.5.5 Video Conferencing

Video Conferencing (VC) is the technology that allows communication between two or more people at different locations by simultaneous two-way audio and video or even text transmissions. It is also known as **video conference** or **video tele-conference** or simply **tele conference**.We can compare this with a video telephone with each participant having a video camera, microphone and speakers mounted on their respective computers/laptops/smartphones etc. As the two participants speak, their voice is carried over the network and the images appear on the monitor of the other participant.

Video Conferencing has become an important tool for communication in the field of business, education, medicine and media. We can now attend lectures being held at some distant location. Also, in the field of medicine, the live demonstrations/ surgeries and procedures are shown worldwide using this technology. Video Conferencing is becoming more and more popular with the advancements in telecommunication technology and reduction in the hardware cost required for it. There are three main types of video conferencing technologies – Point to Point, Multipoint and Streaming.

Point To Point Video Conferencing

In this type of VC, a direct connection is established between two locations that need to communicate with each other. In simple words, it is just like a telephone call with video facility.

Multipoint Video Conferencing

In case of multipoint video conferencing, two or more participants sit in a virtual conference room and communicate as if they were sitting right next to each other.

Streaming Video Conferencing

In this type of video conferencing, the participants may choose to view the meeting on a remote computer or a mobile device using certain VC software/ applications. We can even access the video conference via the web browser.

Video Conferencing is the hybrid of networking, video, audio and much more. Initially video conferencing was a costly affair, so it could be afforded only by a few business organizations but now, with the introduction of relatively low cost hardware , high capacity broadband telecommunication services and video compression techniques, video conferencing has become quite popular in almost all fields.

6.5.6 Social Networking

Social networking is another Internet service that allows people to build social relations on the net. The websites that provide such services are known as **social networking websites**. Facebook is one of the most commonly visited social networking websites. The people connected on social networking websites share common interests or have real life connections to form an online community of internet users.

The journey of social networking websites started around 1978 with the invention of Bulletin Board System (BBS) in Chicago. This BBS was used to make announcements, inform friends about an event or even share information by posting messages. By 1997, certain other websites like six degrees became popular as it allowed the users to create profiles and list friends. A profile consists of user's personal information, social links etc.

Various other social networking websites like Friendster, Myspace, Orkut, LinkedIn etc. were launched but Facebook is the most commonly used social networking site today with over one billion active users. It was founded by Mark Zuckerberg on 4th February, 2004. Initially it was restricted to only Harvard University students but now it allows anyone who is more than 13 years old to become a registered user of this social networking site.

The users first need to register with the Facebook website and then create his/ her profile, add other users as friends, exchange messages and notifications. Registered users may also join common-interest groups. The institutions, companies or organizations may form Facebook pages and accounts to promote their products on the social platform.

Most social networking sites such as Twitter, Facebook etc. have dedicated apps for smartphones and other such hand-held devices.

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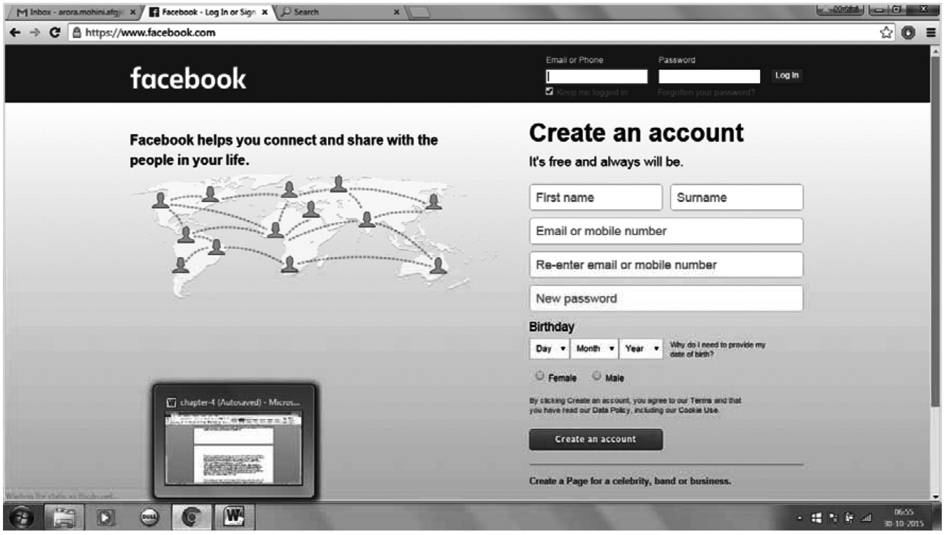

Fig. 6.3: Home Page of Facebook

6.6 COOKIES

The name cookie is taken from 'magic cookies' in UNIX. These are tokens that are attached to the program or user and change according to the responses by the program or the user.

A cookie is the message given to the web browser by a web server. The message received by the browser is stored in a text file and is sent back to the server each time the browser requests a page from the server. In this manner, cookies help the web server to keep track of the user's activity on a specific website. When you open a website containing a cookie, we may be asked to enter our personal information through a form. This personal information like name, address, hobbies etc. is packaged into a cookie and sent to the web browser which stores it for later use. The next time when we open the same website, the browser will send the cookie to the web server which can use this information to present you customised web pages. Hence a cookie contains information that is freely provided to the web site by you.

These are neither plug-ins nor any of the malicious programs. Further, as they cannot access the hard drive of our computer, so they are not capable to spread viruses.

6.7 CLOUD COMPUTING

Cloud computing is the latest technology that has revolutionized the manner in which data and applications are stored, used and shared using Internet. This technology relies on sharing the resources (such as data and application programs) rather than storing them on local servers or personal devices.

In Cloud computing, the word 'cloud' signifies Internet. Hence Cloud computing means Internet based computing. Various services, called cloud services are delivered to users through Internet at any time and at any place. The Cloud services include use of software and storage space over the net. Since the data storage and processing is centralized, there is no need of installing different applications on our machine. This makes cloud computing extremely cost effective. The only thing required for cloud computing is the web browser and an internet connection. You will learn cloud computing in detail in the cloud computing lesson.

INTEXT QUESTIONS 6.2

Fill in the blanks.

1. Email refers to ....
2. The process of authoring or editing a blog is called as ....
3. The three types of video conferencing techniques are ...., ..., ...
4. Cloud computing relies on .... resources rather than storing them on local servers or personal devices.
5. The blogs which are created and edited by multiple users are known as ....
6. .... is also known as "SMS of the Internet".

WHAT YOU HAVE LEARNT

- Internet is a network of networks because it is made up of thousands of smaller networks that can exchange information with each other.
- The collection of web pages interlinked with each other through hyperlinks is known as website.
- WWW is a system of Internet servers that support documents formatted using HTML.
- Web browser is a free software application that is used to view web pages, graphics etc.

- HTML is a markup language that specifies the web page layout and hyperlinks through special layout command called tags.
- XML defines set of rules for encoding documents in a format which is both human and machine readable and hence can be read by any XML compatible application.
- The process of authoring or editing a blog is called as blogging.
- Cookie is the message given to the web browser by a web server.

TERMINAL EXERCISE

1. Give two examples for each of the following:
   - (a) ISP
   - (b) Web browsers
   - (c) Social Networking Websites
   - (d) Instant Messaging Services
2. Explain URL and its parts with the help of an example.
3. What is the need of IP addresses on a network?
4. How data is transmitted from one computer to another on Internet?
5. Explain the working of Internet.
6. Differentiate between
   - (a) Instant Messaging and Chat rooms.
   - (b) FTP and HTTP
7. Why Twitter is known as 'SMS of the Internet'?
8. Define blog, blogging and blog post.
9. Explain Video-Conferencing and types of video conferencing techniques.
10. What is XML?

ANSWERS TO INTEXT QUESTIONS

6.1

1. Network of networks
2. A web browser installed on your computer, a modem, a telephone connection and a connection from an Internet Service Provider (ISP).
3. Advanced Research Projects Agency Network
4. Protocol
5. Homepage
6. Web browser

6.2

1. The messages sent electronically via Internet.
2. blogging
3. Point –to-point, Multipoint and Streaming.
4. Sharing
5. Multi Author Blogs (MABs)
6. Twitter

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7

EMAILING

In the previous lesson you have learnt about Internet communications. Email is one of the most commonly used Internet service. Email stands for Electronic mail which is used for communication among Internet users. Electronic communication is rapidly changing from text to video. Email is known for text message exchange but we can add audio and video contents too in the mail. It is a means/mode of exchanging messages digitally from one person to another. An Email message consists of header, body. Header includes Email addresses of one or more recipients. Descriptive information or subject of Email is called as body of the Email. The ability to reach many people with few keystrokes makes E-mail most convenient. In this lesson you will learn about Email, how to create an email account, how to create a group account in Email, and how to search a particular Email.

OBJECTIVES

After reading this lesson, you will be able to:

- create an Email account;
- create a group Email account;
- search an Email sent by user, by subject;
- apply filter to your Email.

7.1 ELECTRONIC MAIL

Emails have become indispensable part of communication. This is because of various advantages that Email offers:

- It is fast mode of communication as the recipients receive messages within few seconds of sending them. Also same mail can be sent to multiple recipients at once.

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- The mails can be accessed from anywhere in the world just by signing into one's Email account.
- We can attach files of any type in our Email.
- We can keep track of the mails sent and received by us. We can even organize our mails in separate folders.

To send or receive mails, we need to have an Email account. This account is unique for each user and it gives us a definite address to receive and send mails. The following is an example of an Email address:

Student_nios@gmail.com

In the above address, Student_nios is the user's name. 'gmail' is the name of the Email service provider and '.com' at the end shows that it is a commercial domain. The '@' symbol after the user name signifies that it is an Email address.

7.1.1 Creating an Email account

To create an Email account, logon to the desired Email service provider like gmail, yahoo mail, Hotmail etc. and click the '**New User**' link. Follow the instructions and specify the details like user_name, password, name, address, date of birth, phone number etc. as asked in the registration form. Thereafter accept the terms and conditions of the service provider. The new Email account will be created. Now, to access the Email account, specify the user name and password to send or receive the mails and then click on **'Sign In'** button (Fig 7.1).

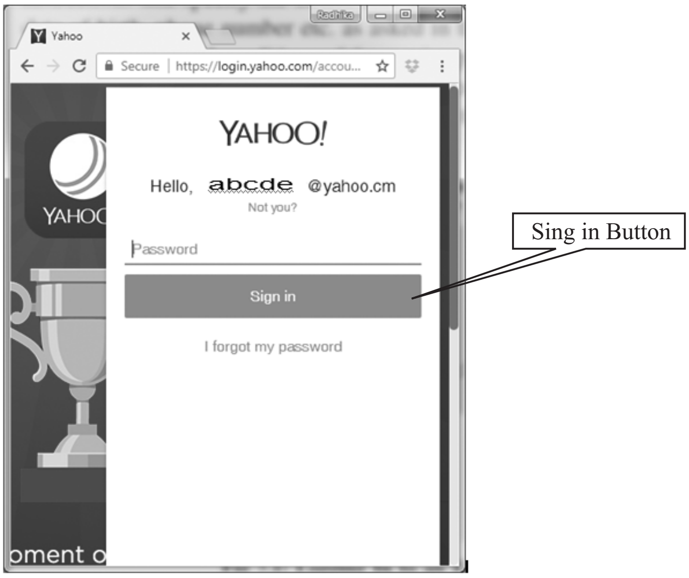
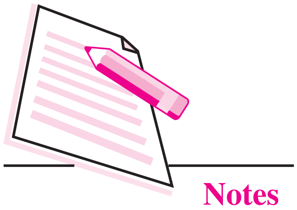


Fig. 7.1: Logging in to an Email account



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If the correct username and password is entered, the Email account will be opened showing the Inbox (Fig. 7.2) that stores the list of received mails in reverse chronological order. That means the mail that has been received last will be displayed on top of the inbox.

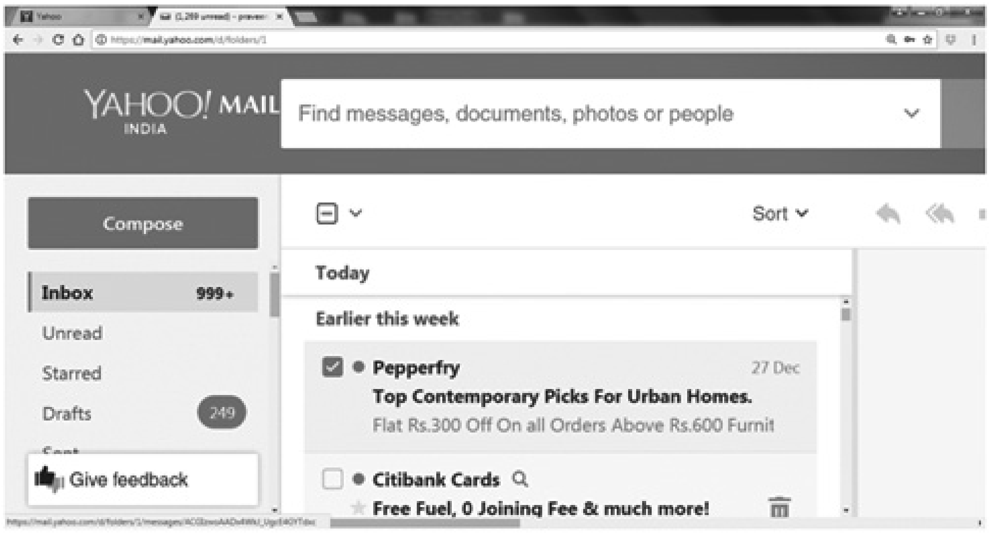

Fig. 7.2: Inbox of an Email account

The list of mails will contain the name of the recipient and the subject of the mail. We can click on any of the mails to view it. Also, a number inside brackets beside the link to the inbox folder will indicate the number of unread mails in the Inbox folder.

To delete a mail, click the checkbox on the left of the mail and click **Delete** button at the top (Fig. 7.3).

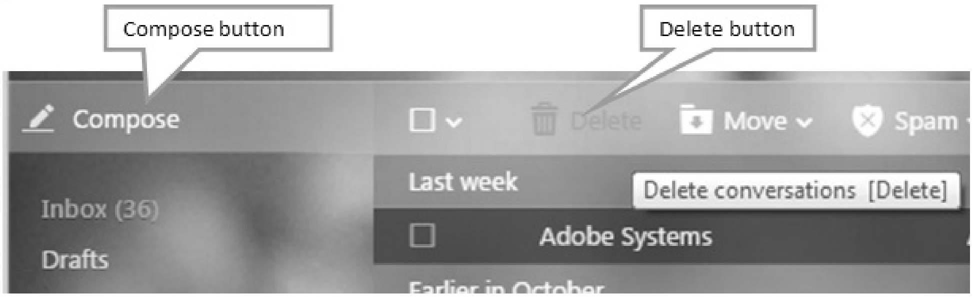

Fig 7.3: Delete and Compose buttons

7.1.2 Send a Mail

To send a mail to single or multiple recipients, follow the steps given below:

(i) Click **Compose** button (Fig. 7.3). The **New Message window** appears (Fig. 7.4).

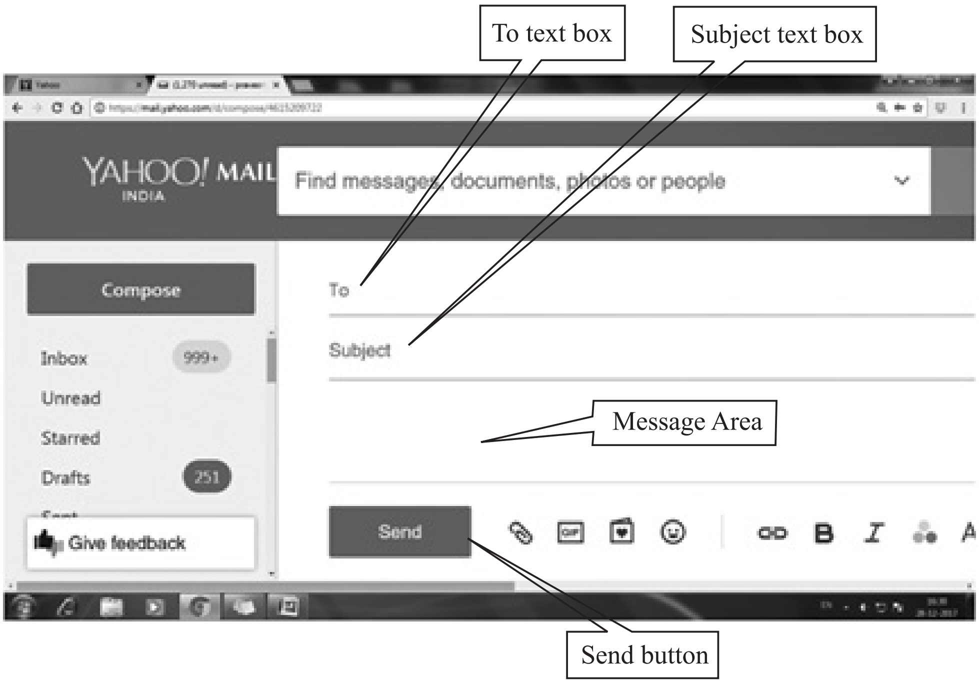

Fig. 7.4: New Message window

(ii) Type the address of the recipient(s) in the **To** textbox. If the same mail has to be sent to multiple recipients separate each address by comma(,). If you want to send the copy of the mail to another person then you can add his/her address in CC or BCC textbox. CC- carbon copy, BCC- Blind carbon copy. The recipients will be able to see the list of addresses mentioned in the CC textbox. But the recipients will not be able to see the addresses mentioned in the BCC textbox.

(iii) Type the subject of the mail in the **Subject** text box. The recipient would see the subject before he opens it.

> *Shortcut key to send the mail is Ctrl + Enter*

(iv) Type the message in the Message Area provided and then click **Send** button.

7.1.3 Reply/Forward a Mail

To reply or forward a mail, open the mail by clicking it in the Inbox. Click the **Reply/Forward** button as desired. If you choose to Reply, the recipient's address will appear automatically in the **To** textbox. However, if you choose to Forward, then type the recipient's address. Thereafter type the message in the message text area and click **Send** button.

Notes

Send an Attachment

One of the advantages of an Email service is that almost any type of file can be sent as an attachment with the Email. The steps to attach a file with an Email are as follows:

Before clicking the send button, please ensure whether you have attached the relevant document.

(i) Open **New Message** box by clicking the **Compose** button. Alternatively the **Reply** or **Forward** button may also be clicked, if required.

(ii) Type the recipient's address, subject and message as described before.

(iii) Click on **Paperclip** icon ( ) to attach the file.

(iv) Browse for the file that you want to attach. Select it and then click **Open** button. The file will start attaching. You will be able to see the progress bar in the New Message window (Fig. 7.5). This may take some time depending on the size of the file.

(v) Click **Send** button to send the mail with the attachment.

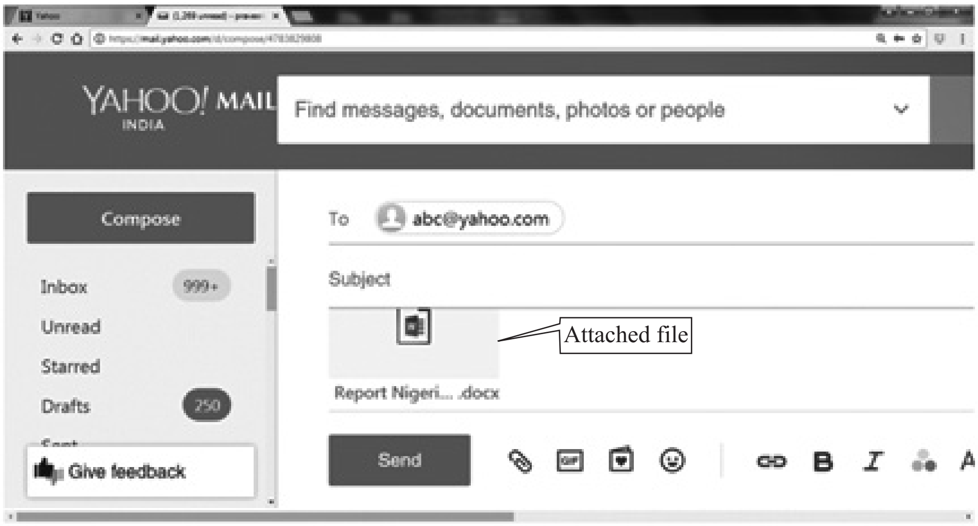

Fig. 7.5: File being attached with an Email

7.1.4 Download an attachment

In the Inbox, the paperclip icon **next to the subject indicates** that it contains an attachment. Open the Email having an attachment. The preview of the attachment will be seen in the mail. Click the **Download** icon (Fig. 7.6) to save the file in the default download folder of the computer.

Fig. 7.6: Downloading an attachment

Always remember to log out of the Email account after the work is done by clicking on **Logout / Sign Out** button. Refrain from closing the browser without logging out because just closing the browser will keep us logged-in. If anyone opens the same browser, she/he may be able to access our e-mail account.

We can attach multiple files with our Email. However, the total size of the attachments is limited according to the mail service. For example, Gmail allows maximum of 25 MB attachment size.

7.2 CREATING A GROUP ACCOUNT IN E-MAIL

Email group account will help you to send same information to a group of people. If you are working in a project or department this Email group will help you to share common messages to all the members of the group. Once you have created an Email group account, you do not have to remember each members name or Email id. you can simply send an Email to the Email group account and all the members of that group will receive the Email simulaueously. Let us now learn, how to create an Email group account using gmail.

Firstly to create an Email group account sign in to your gmail account. Then follow the below mentioned steps to create a group.

1. Click Create Group, on the top left of your screen.

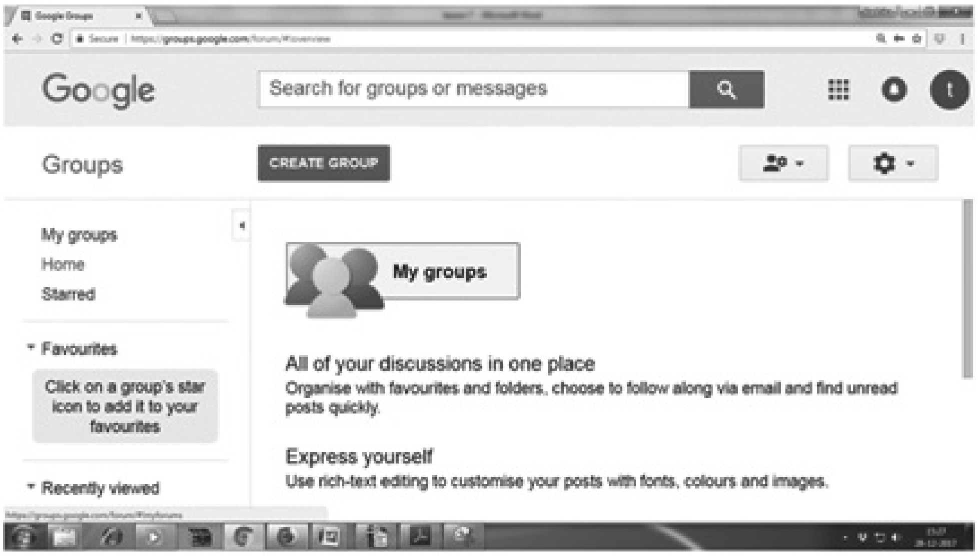

Fig. 7.7: Create group

2. Enter information and choose settings for the group.

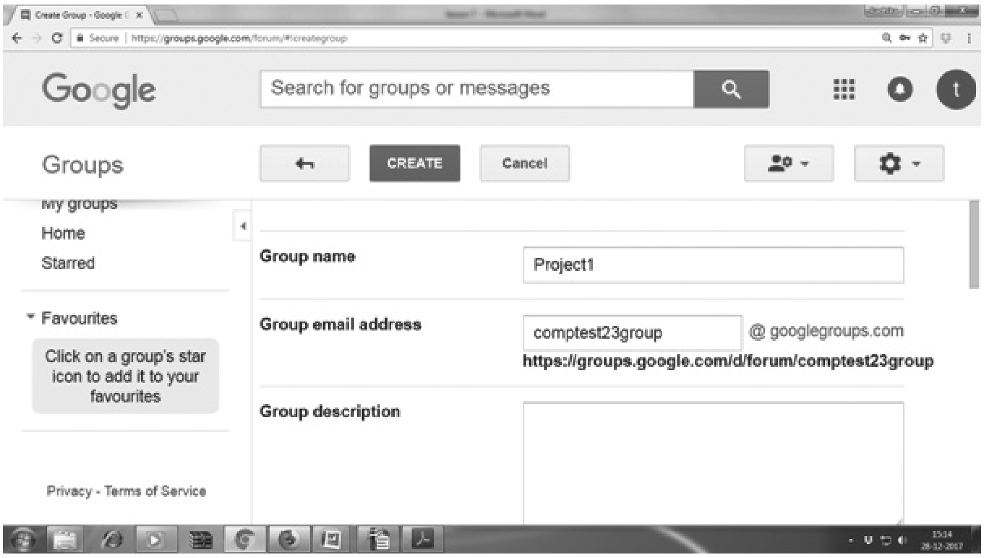

Fig. 7.8: Creating group

3. Enter the basic details of the group account like group name, group Email address, group type, basic permission for the group etc.

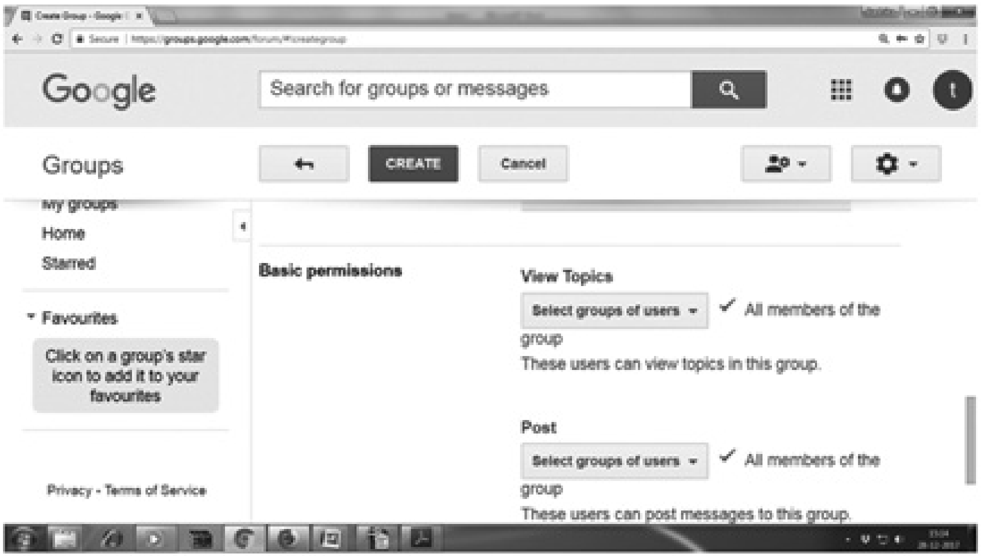

Fig. 7.9: Give permissions for the group

4. Now click Create button.

5. Group account has been created successfully.

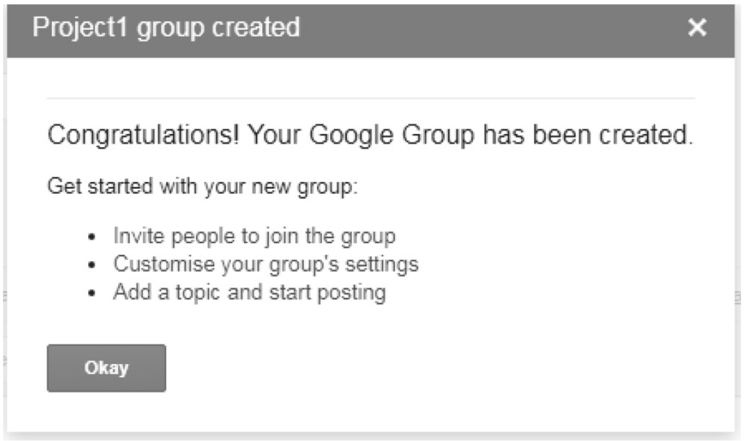

Fig. 7.10: New group creation

6. To manage your group account, select Mygroups on the top left. Choose the group name which has been created. Near the top right, click Manage option.

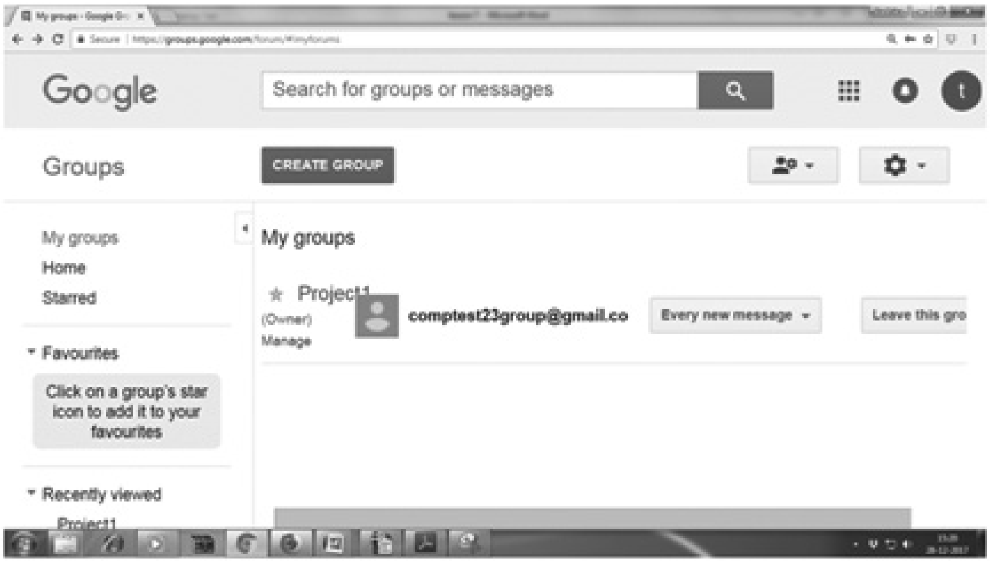

Fig. 7.11: Created groups

7. From the left pane, select Information and choose Advanced option (refer 7.13 also).

Notes

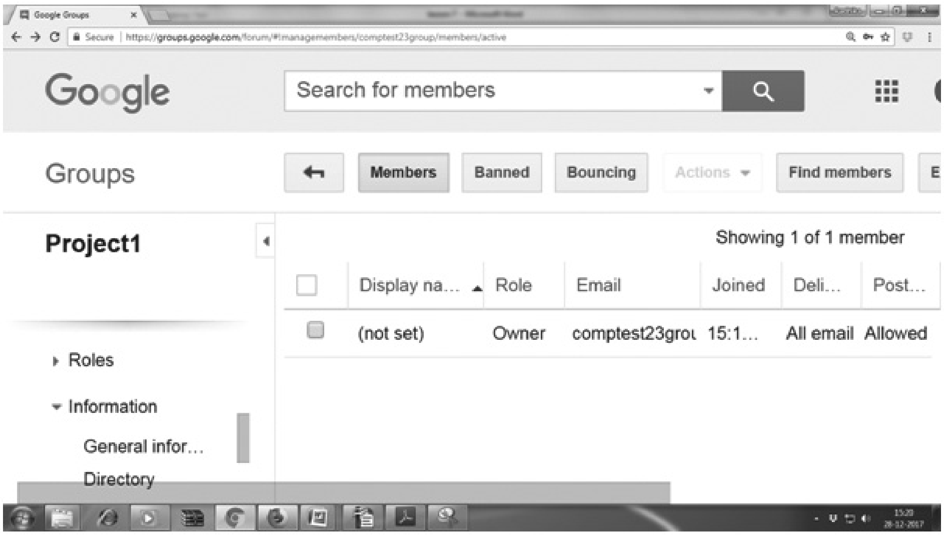

Fig. 7.12: Managing the group

8. To reset a group type, click the **Down arrow** , next to “Select a group type,” (as shown in Fig. 7.13). It will display the options like Email list, web forum, Q & A forum and collaborative inbox. You can choose one of these following options.

   a. **Email list**: Members, communicate with each other using a single email address.

   b. **Web forum**: Members use the Google Groups web forum to communicate with each other.

   c. **Q&A forum**: This is a type of web forum that allows members to ask and answer each other’s questions.

   d. **Collaborative inbox**: Members can assign topics to other members as tasks.

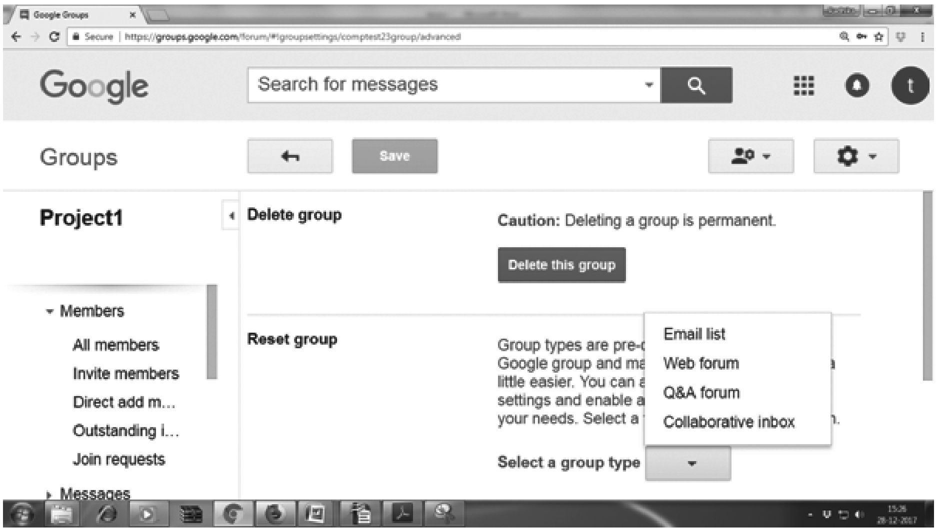

Fig. 7.13: Choose a group type

9. Select Email list option and click Reset this group button. A pop-up window will appear and ask the confirmation from the user to reset the group settings. click on Reset Group button.

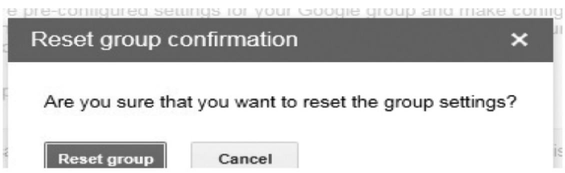

Fig. 7.14: Reset the group

10. You can add / invite members to your group account by choosing Invite members option from the left pane. Enter their email address and send invitations to them.

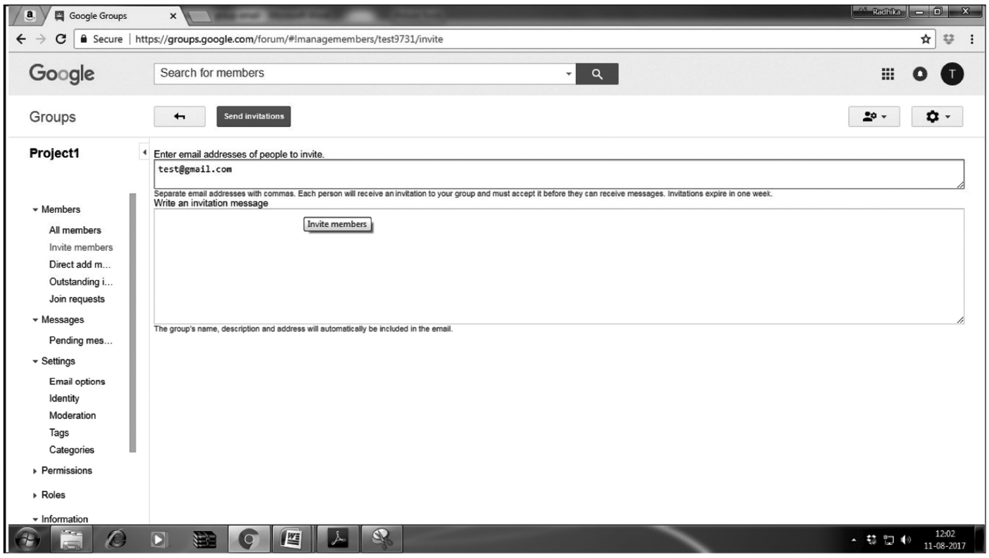

Fig. 7.15: Invite the members

In the same way you can add any number of persons in your group account. Once the request has been accepted by the members you will be able to send or receive Emails to or from this group Email account. You can remove / add members to your group Email account at any point of time.

7.3 SEARCHING AN E-MAIL

You can search any Email sent or received by you. Let us learn how to search an Email using one of these search operators.

Search a mail in Inbox

When you want to search an Email received from a particular contact then type **from : Sender** in the search box of your mail server where sender is the email

Notes

id of the sender whose email you want to search; e.g., To search all the emails sent by Seema type from: Seema or from: seema123@gmail.com in the search box.

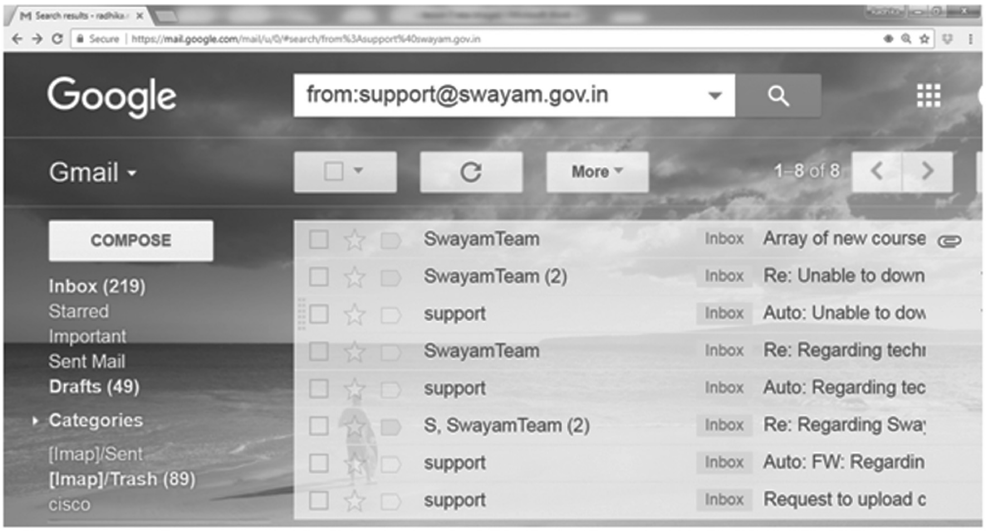

Fig. 7.16: Sent E-mail by user

Email sent to a particular contact

To search all the Emails sent by you to a particular contact, type **to: sender** in the search box. Hence, to search for all the Emails sent by you to Seema, type ***to: Seema***

Email Search by Subject

You can search for a specific Email thread, if you remember the subject line of the message. Use **subject: word** in the gmail search box.

For example, if you are searching for a message which contains the word "project" in the subject line, use **subject: project**

Emails with attachments

The attachment operator of gmail is very handy when you want to list all the Emails that contain attachments. This will search both the sent mail and all mail folder for messages containing an attachment.

To search for all Emails that contain attachments, use **has: attachment** in the search box.

Emails with particular attachment:

Using the attachment operator serves the purpose, but if you have lots of archived messages – you will get hundreds of results for sure. In this case, if

you remember the filename of an attachment, here is a quick way to perform a refined search with attachments.

Type **filename: nameoffile** in the Gmail search box. If you are looking for a message which contains an attachment as project.pdf, use **filename: project.pdf**.

Notes

All email that contains attachment type

This operator is very useful when you want to list all the messages which contain a specific type of attachment. Just use **filename:*.extension**.

For example, if you want to find all attachment as pdf, type **filename:*.pdf**.

Chat message search

Apart from searching emails, gmail lets you search for chat messages using the **is: chat** operator. So if you want to search for a specific chat conversation which may contain the word “Football”, type ***is:chat Football*** in the search box.

7.4 SETTING FILTER

You can manage your incoming mail using gmail’s filters.

(i) Click the down arrow in your search box. A window that allows you to specify your search criteria will appear.

(ii) Enter your search criteria. If you want to check that your search worked correctly, click the search button ( ).

Fig. 7.17: Using Filter in gmail

Notes

(iii) Click **Create filter with this search** at the bottom of the search window. If you need to verify the search results, you can click the **x** to collapse the filter options. Clicking the down arrow again will bring the window back with the same search criteria you entered.

(iv) Choose the action(s) you want the filter to take.

(v) Click on create filter.

Now your filter will be created.

7.4.1 Edit or Delete existing filter

You can edit or delete the filter which you have created.

(i) Click the settings in the top right.

(ii) Select **Settings** (as shown in Fig. 7.18).

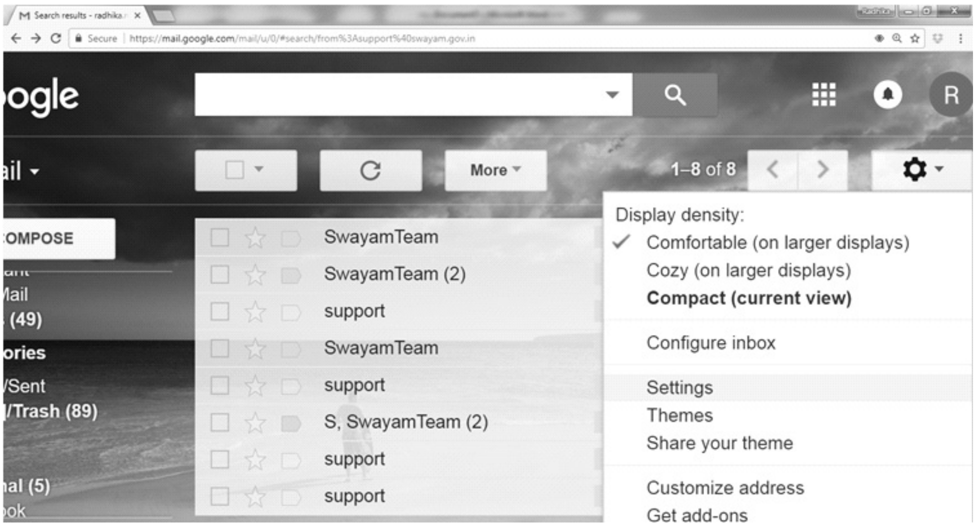

Fig. 7.18: Editing the Filter in GMAIL

(iii) Click the **Filters** and **Blocked Addresses tab** (as shown in Fig. 7.19).

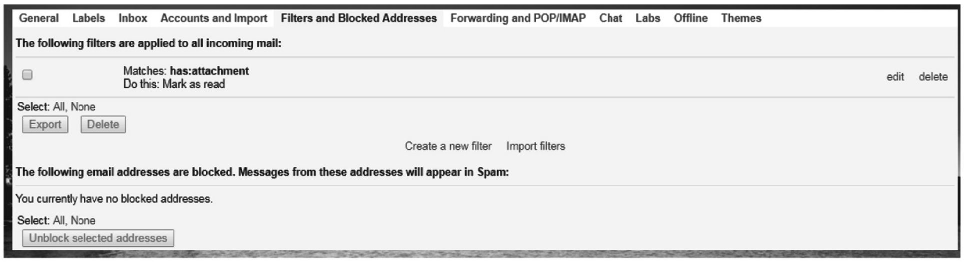

Fig. 7.19: Edit or delete filter

(iv) Find the filter you want to change and click **edit** or **delete** on the extreme right to modify/remove the filter.

(v) If you are editing the filter, enter the updated criteria for the filter in the appropriate fields, and click **Continue**.

(vi) Update any actions and click the **Update filter** button.

INTEXT QUESTIONS 7.1

State whether the following statements are true or false:

1. Email ids are used for communication.
2. Email id can be created on outlook.
3. Gmail uses folders for organizing messages.
4. You can not search an email sent by you.
5. The shortcut key for sending the mail is shift + enter.

WHAT YOU HAVE LEARNT

- Email is a method of exchanging digital messages. It consists of header, envelop and body of the message.
- We can attach or upload any type of file in the email.
- Download the attachment and save it in your computer for using it later.
- Create a group email id for sending the same message to the group of people again and again.
- Search an email by using subject, date or sender.

TERMINAL EXERCISE

1. How will you create groups in Emailing?
2. How to edit and delete filtering in gmail account?

Notes

3. Write any two differences between OR and IN operator in searching an Email.
4. Write the steps for sending an attachment in Email.
5. Why Email is important for communication?

ANSWERS TO INTEXT QUESTIONS

7.1

1. True   2. True   3. False   4. False   5. False

8

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DIGITAL DOCUMENTATION

In the previous module you have learnt about basic computing. Now, in this lesson you will learn about digital documentation. Documentation is part of our life today. We all are very familiar with a paper document which is a document on a paper. On the other hand, a digital document is a document that is available in electronic form. Whether we are in school, office or business, we read printed **text** in one form or another. Everyday we come across printed material in the form of books, newspapers, magazines, notices, circulars, date sheets, tutorials, admission forms, resumes etc. Few years back all the printed material was available on paper but now we are moving more towards digital documentation. This is a more convenient and eco-friendly way because we save paper and at the same time, the document can be edited, formatted, copied and shared much more easily as compared to printed text. Also, today, we are in a technological era where we have books, tutorials, examination papers, newspapers etc. in digital form.

OBJECTIVES

After reading this lesson, you will be able to:

- define Word processing and Word processors;
- create documents using Apache OpenOffice Writer;
- save, print and close a document;
- apply various editing and formatting features;
- use the find and replace feature;
- insert headers and footers;
- create and work with tables;

Notes

- insert images and other gallery objects;
- use track changes and mail merge feature;
- use OpenOffice Writer help.

8.1 WORD PROCESSING AND WORD PROCESSORS

A word processor is an application software that is used for creating, editing, formatting and printing any type of textual data. This textual data that is created using a word processor is called a **document** and the process of using a word processor is called **word processing**. A document may consist of text, images, drawings, tables etc. Both paper documents and digital documents are created using a simple text editor like Notepad or any word processor like MS Word or OpenOffice Writer. Before the coming of Word Processors in 1980s, this work was done either manually or using a typewriter.

8.1.1 Features of Word Processor

The following are the common features of a word processor:

(i) A word processor allows us to save a document and also to make modifications in an already created document very easily. We can change the appearance of the text by making it bold, italic or by changing its colour, size or style.

(ii) Using a word processor, we can insert images, pictures, tables, etc. in our documents.

(iii) The Find and Replace feature of a word processor allows us to find and replace a particular word in the document.

(iv) The Spelling and Grammar check feature of a word processor helps to make automatic corrections in the document. It also gives thesaurus containing synonyms and antonyms of words.

(v) The OLE (Object Linking and Embedding) feature allows us to embed objects like charts, pictures, audio, video, etc. in our document.

(vi) A word processor has a unique feature called Mail Merge which allows us to send personalized letters, invitations etc., to multiple people.

(vii) Art gallery allows inserting a picture.

There are many word processors available in the market like MS Word, OpenOffice Writer, WordPerfect etc. More or less all of these have all the features required for creating a good digital document. Microsoft Word has been the most popular word processor since many years but now with the development

in open source software, the OpenOffice Writer is increasingly being used by more and more users. The advantage with OpenOffice is that it can be downloaded free of cost from Internet. One of the links from where you can download OpenOffice Writer is *www.openoffice.org*. In this lesson you will learn about digital documentation using Apache OpenOffice Writer (version 4.1.1).

8.2 STARTING OPENOFFICE WRITER

OpenOffice Writer or simply Writer is a word processor that is part of OpenOffice Suite. It is a What You See Is What You Get **(WYSIWYG)** application which means that the print out of the document will look exactly as we see on the computer screen.

To start Writer, follow the steps given below (Fig. 8.1):

1. Click **Start** button.
2. Click **All programs.**
3. Click **OpenOffice.org**
4. Click **OpenOffice Writer**

Fig. 8.1: Starting OpenOffice Writer

Notes

The writer window appears as shown in Fig. 8.2 below.

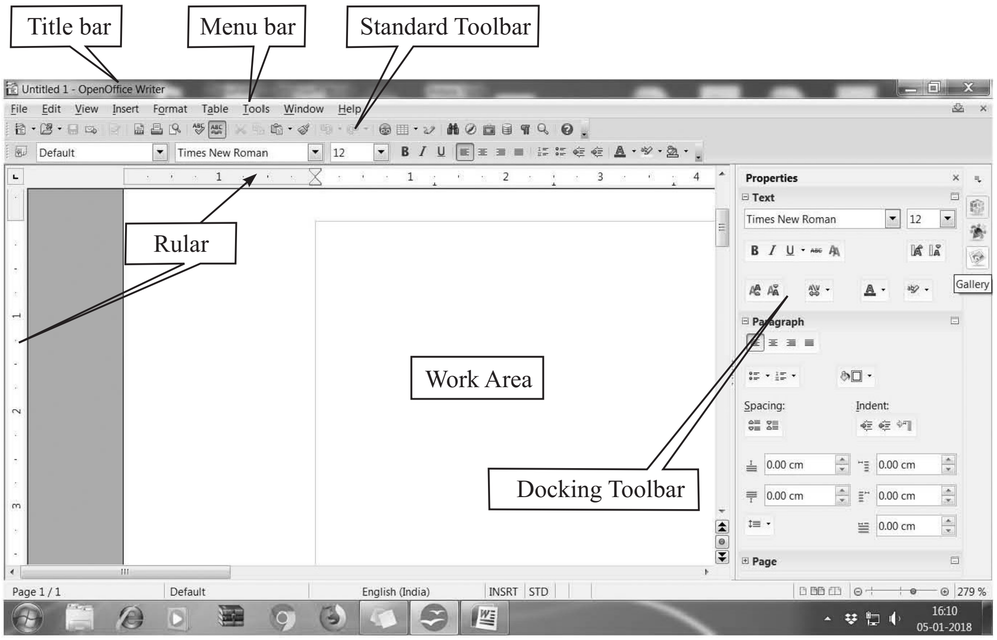


Fig. 8.2: Writer Window

The main components of Writer window are as follows:

Title Bar: It is present on the top of Writer window and it displays the name of the document and the name of the application (*i.e. OpenOffice Writer*). On the right side of the Title bar, you will find the three Window Control buttons to minimize, maximize/restore and close the Writer window.

Menu Bar: Below the title bar is the menu bar which contains various menu items - File, Edit, View, Insert, Format, Table, Tools, Window and Help.

Standard Toolbar: Below the menu bar is the Standard toolbar which contains buttons for frequently used commands such as New, Open, Save, Print, Cut,Copy, Paste etc.

Formatting Toolbar: This toolbar consists of commands that help in formatting the document like font style, size, colour, bold, italic, underline etc.

Work Area: It is the area where you type the text. It can hold unlimited text which may include characters, pictures, drawings, or symbols. The vertical blinking line in the work area is called **insertion point** or **cursor**. The location of this cursor determines where the next character will be inserted.

Status Bar: This is located at the bottom of the Writer window and gives information about the current document like its word count, page number, number of pages and language used.

Scroll Bars: There are two scroll bars on the Writer Window:

- *Horizontal Scroll Bar:* It helps to navigate the document left and right.

- *Vertical Scroll Bar:* It helps to navigate the document up and down.

We can click the arrows on the either side of the scroll bars to navigate through the document.

Rulers: The Writer window has two rulers:

- *Horizontal Ruler:* This is located at the top of the document and helps to define indents and also the left and right margins.
- *Vertical Ruler:* This is located to the left of the document and helps to define top and bottom margins.

Docking Toolbars: On the extreme right of the window, Writer provides you with four icons –Properties, Styles and Formatting, Gallery and Navigator. By clicking on any of these icons, the corresponding docking toolbar opens containing various buttons to format text, apply styles, insert pictures and navigate through the document respectively.

8.3 CREATING A NEW DOCUMENT

When we start OpenOffice Writer, the Writer window opens with a new document. But if the Writer window is already open, follow the steps given below to open a new document:

> *Press Ctrl + N to open a new document.*

1. Click **File → New** (Fig. 8.3)
2. Choose the **Text Document** option from the submenu. The new document opens.

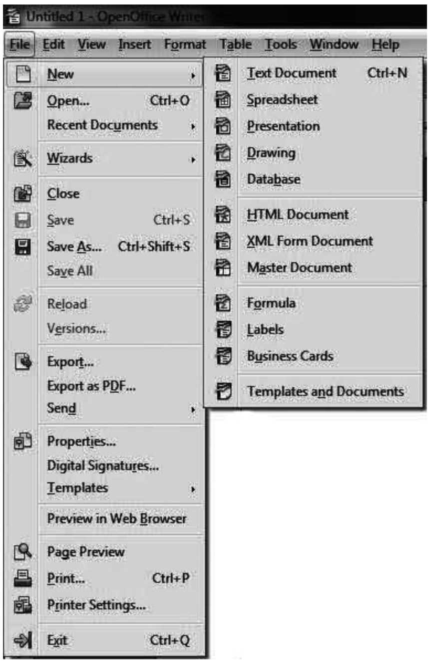


Fig. 8.3: File Menu

8.4 SAVING A DOCUMENT

Saving a document is necessary for future use. Also, we need to save the document after any changes are made to it in order to retain those changes. When we save the document, it gets stored in the hard disk of the computer. To save the document for the first time, follow the steps given below:

1. Click **File** → **Save As**. The **Save As** dialog box appears (Fig. 8.4).

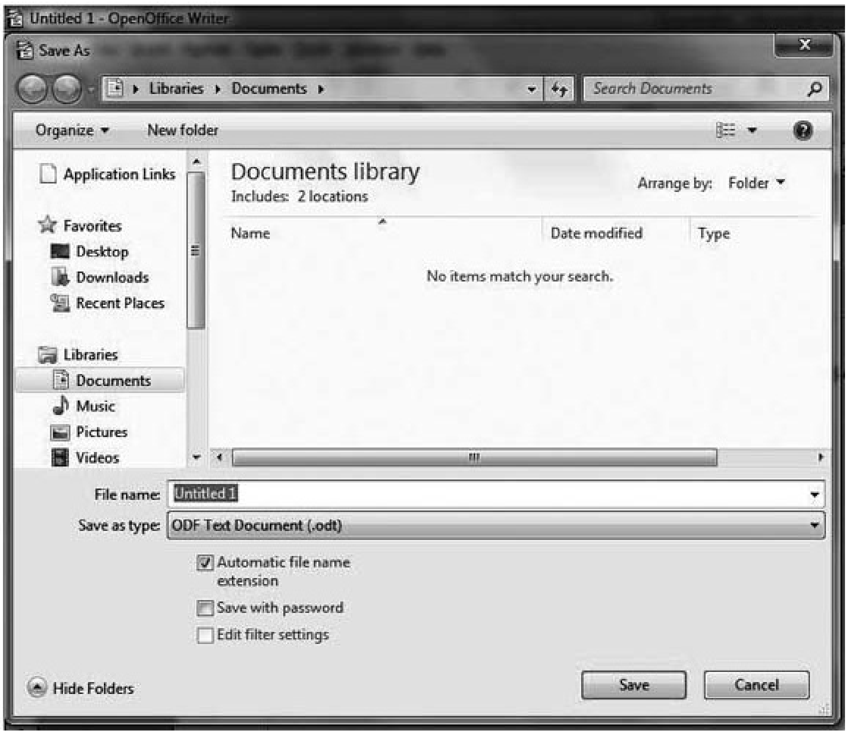


Fig. 8.4: Save As dialog box

2. Browse for the folder where the file has to be saved.
3. Type the name of the file in the **File name** text box.
4. Click **Save** button. Although Writer allows us to save the document in variety of formats but by default, the file created and saved in OpenOffice Writer will be saved with an extension **.odt**. Thereafter, the name of the file will appear on the title bar of the document.

> *Press Ctrl + Shift +S to save document for the first time and Ctrl+S to save otherwise.*

We can also save the document by clicking on **Save** button on the Standard toolbar (Fig. 8.5). Please note that the **Save As** dialog box appears only when we are saving the document for the first time. However, if the same file has to be saved with a different name or at a different location, then select **Save As** option again from the **File** menu.

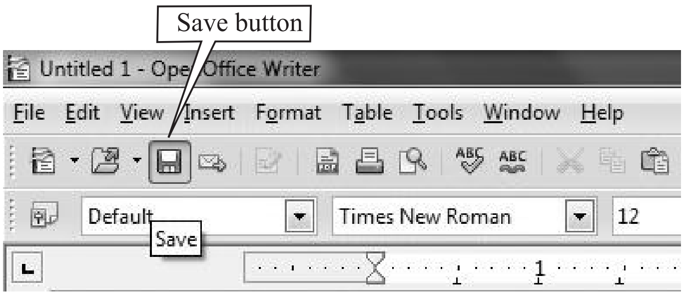


Fig. 8.5: Save button

8.5 PRINTING THE DOCUMENT

After creating the document, we might need to print it on paper. Before starting the process of printing, make sure that the printer is connected to the computer and then follow the steps given below:

Press Ctrl +P to open the Print dialog box.

1. Click **File → Print**. The **Print dialog box** appears (Fig. 8.6).

2. The left hand side of the Print dialog box contains the Preview of the document that helps to see how the document will look when it is printed. On the right side, there are various tabs. From the **General** tab, select the type of Printer, number of copies that have to be printed and then click on **Print** button.

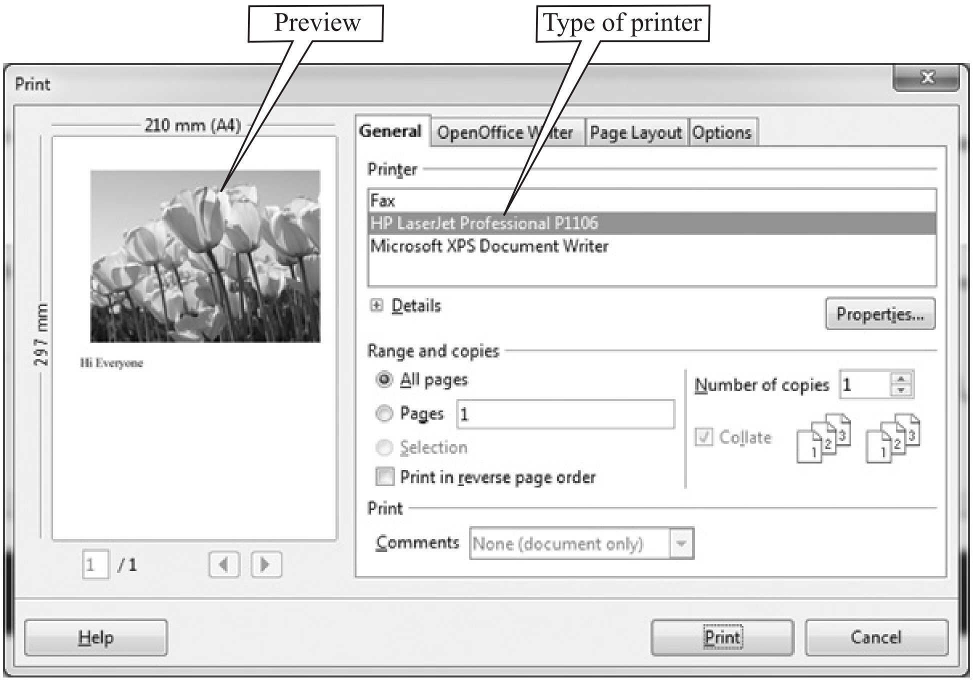


Fig. 8.6: Print dialog box

To print directly without opening the **Print** dialog box, click **Print File Directly** button on the Standard Toolbar (Fig. 8.7).

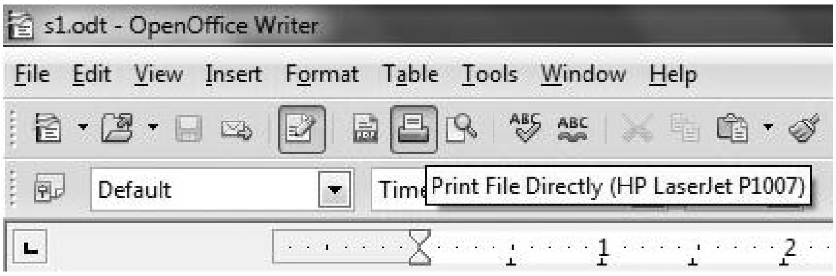


Fig. 8.7: Print File Directly Button

Before printing, to see the document as to how it will look on the paper, select **Page Preview** button from the **File** menu. The Page Preview screen appears (Fig. 8.8).

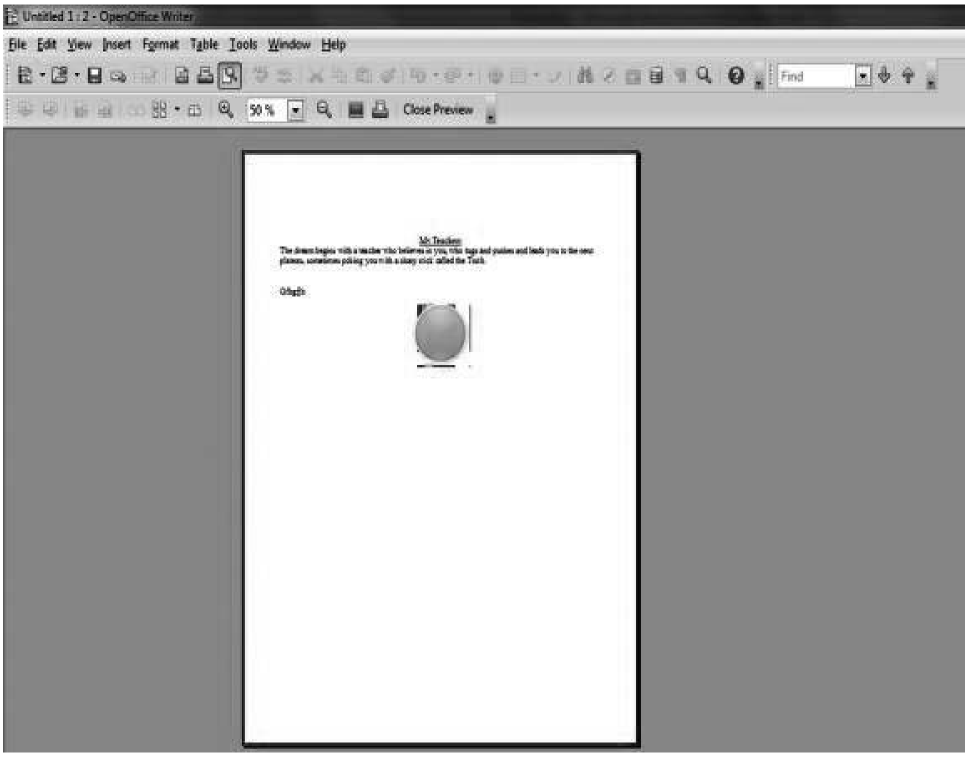


Fig. 8.8: Page Preview

We can zoom in and zoom out the document in this view. To go back to the normal view, click **Close Preview** button.

8.6 CLOSING OPEN OFFICE WRITER

After finishing our work, we can close the document without closing the Writer window by selecting **Close** option from the File menu.

If we want to exit Writer, click **Close** button ( ) on the top right corner of the Writer window. Alternatively we can click **File** → **Exit** option.

Press Ctrl +Q to exit Writer.

In either of the ways described above, if our document to be closed is not saved, then Writer prompts to save the document by displaying a message box as shown in the Fig 8.9.

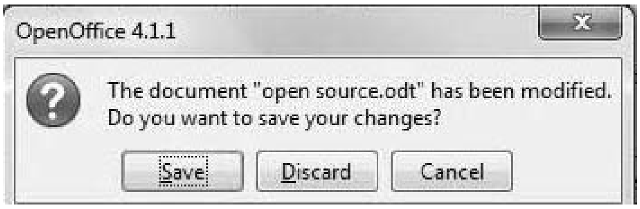


Fig. 8.9: Message Box to Save the document

Click **Save** button to save, **Discard** button to close the document without saving and **Cancel** button to cancel the closing process and continue working with the current document.

8.7 OPENING AN EXISTING DOCUMENT

To open an already saved document in Writer, navigate to the folder where the file is saved and then double click to open it. However, if the Writer window is open, we can follow the steps given below to open the file:

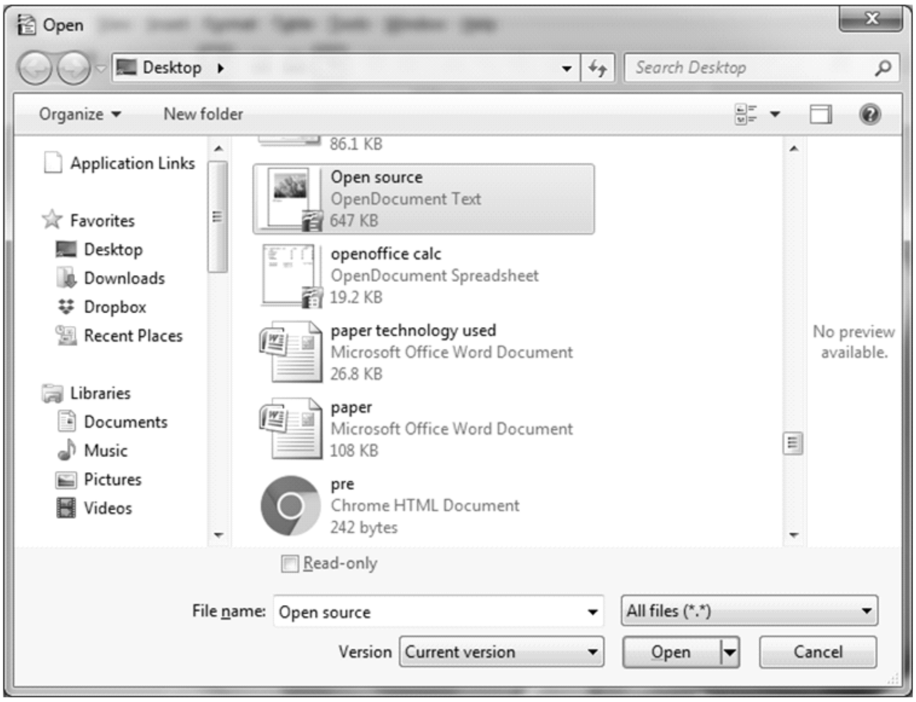


Fig. 8.10: Open dialog box

1. Click **File** → **Open**. The **Open** dialog box will appear (Fig. 8.10).
2. Browse the folder in which your file is saved.
3. Select the file to be opened. The name of the file appears in the **File Name** text box.
4. Click **Open** button and the document will be displayed in the Writer window.

Press Ctrl +O to open an existing document.

8.8 EDITING A DOCUMENT

Editing is the process of making changes in the document in any manner. It may be by changing the contents, by rearranging words or paragraphs, by correcting mistakes or by even by changing the appearance of the text.

OpenOffice Writer provides us with various options to modify our document. But first, the text to be modified has to be selected.

8.8.1 Selection of Text

We can use either a keyboard or a mouse to select any text in the document.

- *Using a Mouse*:Keep the mouse pointer in the beginning of the text(for example, a character, word or paragraph) that you want to select. Click and drag the mouse pointer till the entire text is selected. The selected text (*Open Source Software* in Fig. 8.11) is highlighted in blue colour.

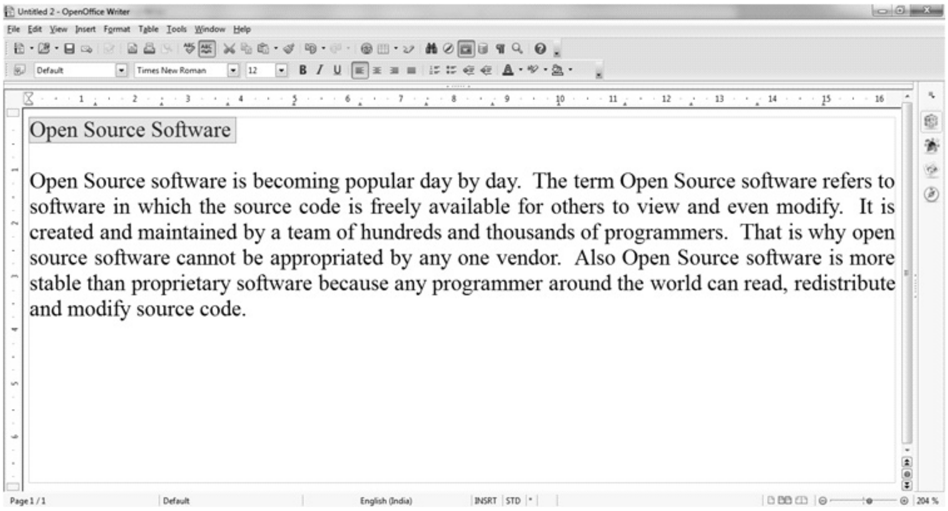


Fig. 8.11 : Selected text in blue colour

- *Using Keyboard:*To select the text using a keyboard, place the cursor before the text that you want to select. Holding down the **Shift** key, press one of the arrow keys in the direction of required selection. Also, there are various shortcut keys available to select the text. The table 8.1 lists some of these.

Table 8.1: Shortcut keys for selecting the text

Shortcut	Key Selection
Shift + End	To select the line from cursor position to end of the line.
Shift + Home	To select the text from the cursor position to the beginning of the line.
Ctrl + Shift + ↓	To select the text in a paragraph from the cursor position to the end of the paragraph.
Ctrl + Shift + ↑	To select the text in a paragraph from the cursor position to the beginning of the paragraph.
Ctrl + Shift + Home	To select the text from the cursor position to the beginning of the document.
Ctrl + A	To select the complete document.

8.8.2 Copying Selected Text

Copying text means to duplicate the text. The text is present at the original place and at the same time we paste it at a new location also. Any text on the document, may it be character, word, sentence or paragraph can be copied by following the steps given below:

1. Select the text that has to be copied.
2. Click **Edit → Copy**.
3. Place the cursor where the text has to be pasted.
4. Click **Edit → Paste.**

8.8.3 Moving Selected Text

While copying, we place the duplicate text at the new position but while moving the selected text, the text is removed from the original location and pasted at a new location. The steps to move the text are as follows:

1. Select the text that you want to move.
2. Place the mouse pointer anywhere on the selected text.
3. Drag the selected text to the desired place.

You may also use the Cut, Copy and Paste buttons on the Standard toolbar (Fig. 8.12) to cut, copy and paste the text in the document respectively. Alternatively, if we right click on the selected text, a pop up menu will be displayed. Select **Copy, Cut or Paste** options as required.

Press Ctrl +C to copy, Ctrl + X to cut and Ctrl + V to paste the selected text.

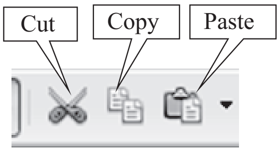


Fig. 8.12: Cut, Copy and Paste buttons Standard toolbar

8.8.4 Deleting the selected text

To delete the selected text, perform the following steps:

1. Select the text to be deleted.
2. Press **Delete** key on the keyboard. The selected text gets deleted.

8.9 FINDING AND REPLACING TEXT

The **Find and Replace** feature of Openoffice Writer helps us to search for a particular word, phrase or sentence in a document and replace it, if required. The replacements may be done once or for multiple number of times.

To find a word in your document follow the steps given below:

1. Click **Edit → Find and Replace** (Fig. 8.13). The **Find and Replace** dialog box appears (Fig. 8.14).

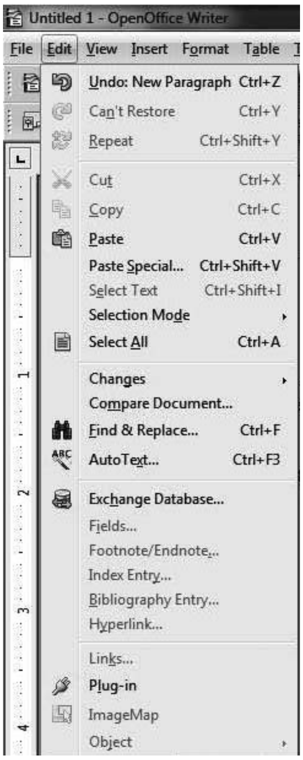


Fig. 8.13: Find and Replace option

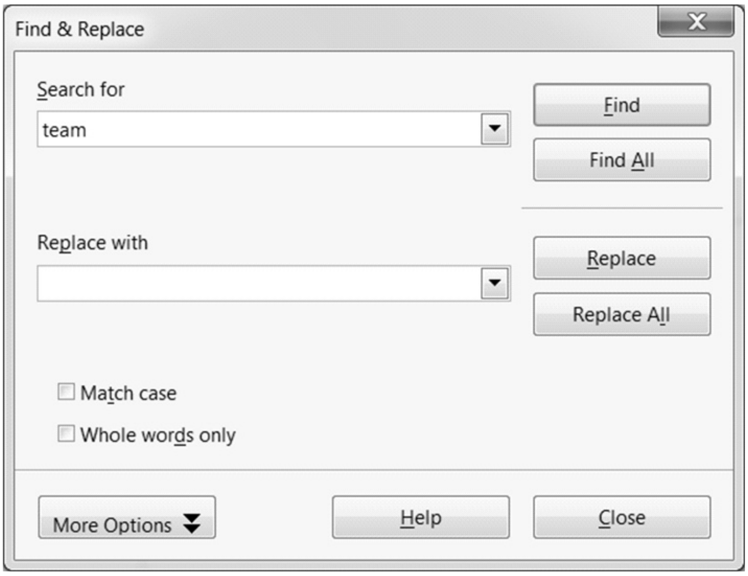


Fig. 8.14: Find & Replace dialog box

2. Type the word (*team* in our example)to be found in the **Search for** text box.

3. If the word that is being searched has to be in the particular case only, select **Match case** option. If we want to search only complete words click **Whole Words only** option.

4. Click **Find** button. The first occurrence of the typed word (team) gets selected in the document as shown in the Fig 8.14.

5. To find more occurrences of the word, keep on clicking the **Find** button till the last occurrence of the word is displayed. A message box stating that '*End of the document has been reached*' and whether you would like to start the search again from the beginning will be displayed. Click **Yes** button in the message box to resume the search from the beginning of the document and **No** otherwise (Fig. 8.15).

Press Ctrl + F to open the Find & Replace dialog box.

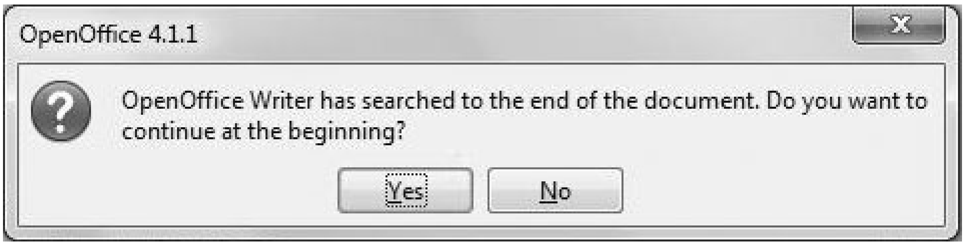


Fig. 8.15: Message box on completing the search

6. Click **Close** button to close the **Find and Replace** dialog box at any point of time.

Notes

8.9.1 Replacing Text

To replace the text, open the **Find and Replace** dialog box as explained above and then perform the following steps to replace the character, word or phrase with some other character, word or phrase.

1. Type the word to be replaced in the **Search For** text box (*team* in our example).
2. Type the new word that we want to replace with in the **Replace With** text box (say, *group*).
3. Click **Replace** button if only one occurrence of the found word has to be replaced. However, to replace all the occurrences of the word, click **Replace All** button.

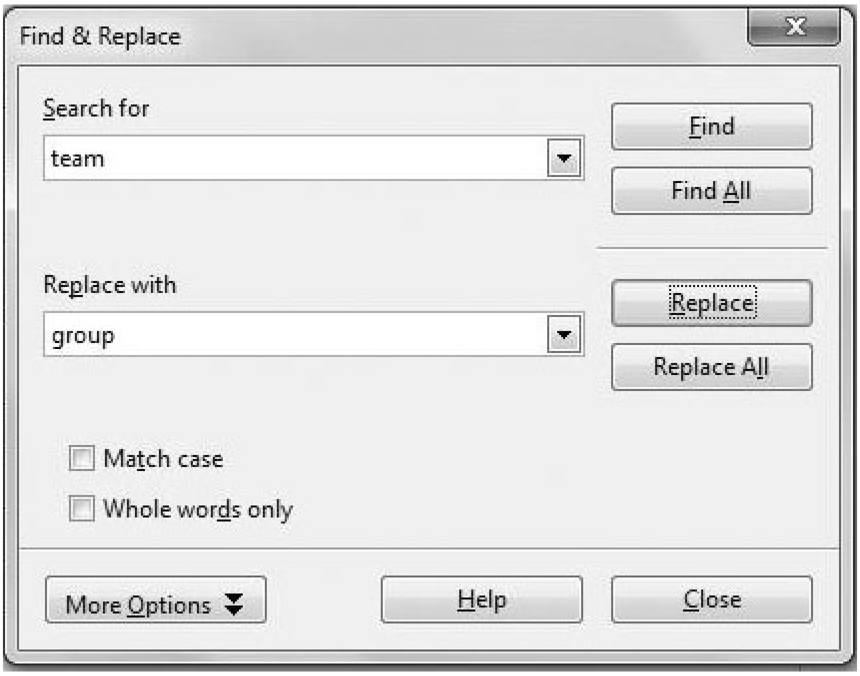


Fig. 8.16: Finding and Replacing text

8.10 FORMATTING THE DOCUMENT

The process of improving the appearance of text in a document by changing text alignments, font, size, style etc. is called **formatting**. It helps in highlighting headings and other such important text by differentiating it from regular text. Formatting can be of three types –

- Character Formatting
- Paragraph Formatting
- Page Formatting

Notes

8.10.1 Character Formatting

This type of formatting is used for individual characters or set of characters in a document. It includes applying font style, size and other text attributes viz. bold, italic, underline etc. To apply character formatting, follow the steps given below:

1. Select the text to be formatted.
2. Click **Format** → **Character** option. The **Character** dialog box appears (Fig. 8.17).

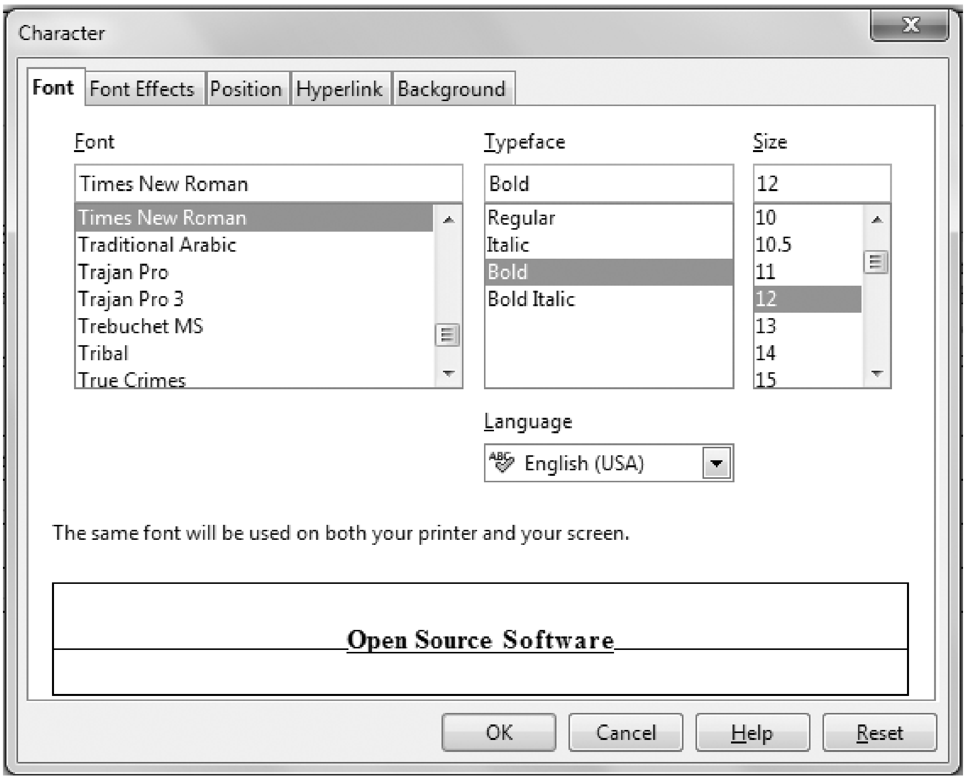


Fig. 8.17: Character dialog box

3. By default, the **Font** tab is selected. From the **Font list box**, select the desired font. The preview of the selected font is seen at the bottom of the **Character dialog box**.
4. Similarly select the font size, typeface and other text attributes.
5. Click **OK** to apply the selected effects and close the dialog box.

Press Ctrl +B, Ctrl + I or Ctrl + U to make the text bold, italic or underline respectively.

The Formatting toolbar (Fig. 8.18) on the Writer window contains buttons to apply various formatting effects to the text in our document. Select the text on

which the formatting effects are to be applied and then choose the appropriate button from the toolbar. For example, to make the text bold, click the **Bold** button after selecting the text.

Fig. 8.18: Formatting toolbar

8.10.2 Changing Case

Text in OpenOffice Writer can be written in any of the following five types of cases:

- Sentence Case: First letter capital (My country)
- Upper Case : Capital alphabets (MY COUNTRY)
- Lower Case: Small Alphabets (my country)
- Capitalize Every word: First letter of every word is capital (My Country)
- Toggle Case: reversing the existing case

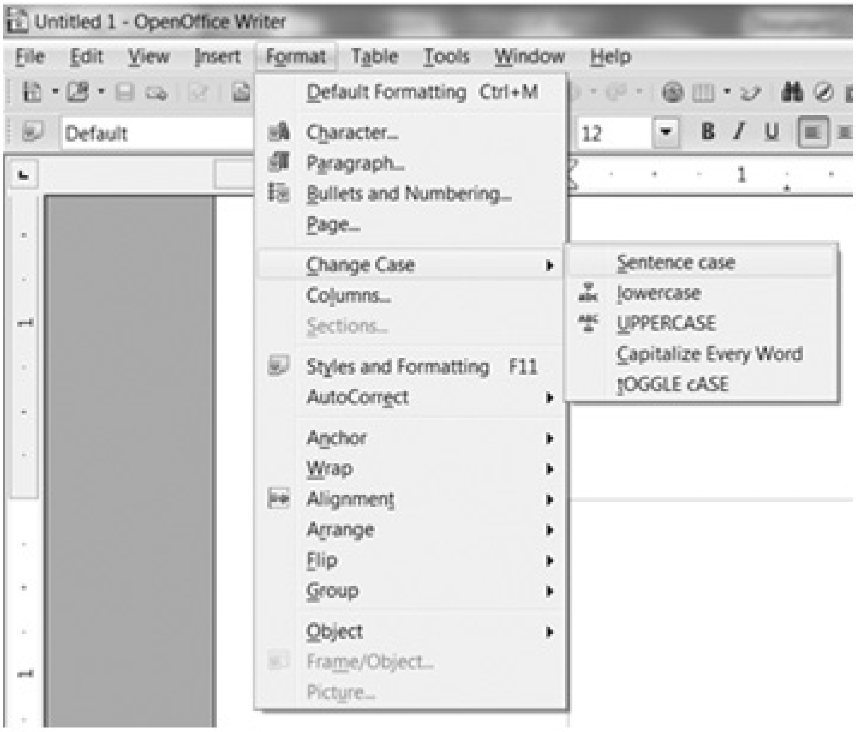


Fig. 8.19: Change Case option

To apply a particular case, select the text and click **Format → Change Case** (Fig. 8.19). Click on the desired case option to be applied to the selected text.

8.10.3 Paragraph Formatting

To format a paragraph we can set its right, left, top and bottom margins, align the text, set indents and spacing between the text and lines and so on. The Formatting toolbar contains buttons to apply various formatting effects to the document (Fig. 8.18).

Text Alignment: The Formatting toolbar has the buttons to align the text in four ways – Left, Right, Center and Justify. Select the paragraph and then click on the desired alignment button on the Formatting toolbar.

Indentation and Spacing: Indentation refers to the blank spaces in the beginning of the paragraph and Line Spacing refers to space between two or more lines in a paragraph. A document with increased line spacing has good readability but at the same time consumes more space. By default, all indents and spacings are measured in centimetres (cms) in OpenOffice Writer. Perform the following steps to set line spacing and Indentation:

1. Select the paragraph whose line spacing has to be set.
2. Select **Format** → **Paragraph**. The **Paragraph** dialog box appears (Fig. 8.20).

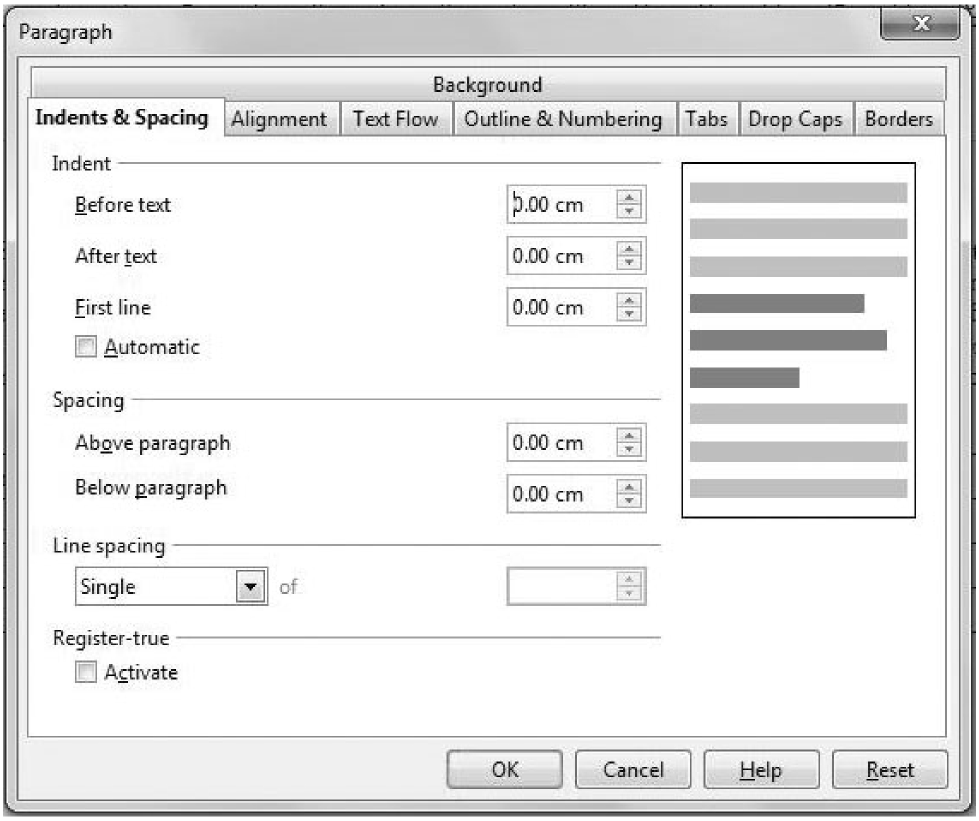


Fig. 8.20: Paragraph Dialog Box

3. Select **Indents and Spacing tab** in the Paragraph dialog box.
4. Set the Indents in the Indents section. The indent options available are:
   - Left indent: This moves the text to the left side of the document. We have to specify the **Before Text** value in the Indent section.
   - Right indent: This moves the text to the right side of the document. We have to specify the **After Text** value in the Indent section.
   - First Line indent: This moves only the first line of the paragraph to the right.
   - Hanging Indent: The first line is less indented than the rest of the paragraph.
5. From the **Line Spacing List Box**, select the desired line spacing.
6. Click **OK** button.

Increase Indent or Decrease Indent buttons on the Formatting toolbar can be used to indent the paragraphs.

8.10.4 Page Formatting

Page formatting includes giving desired settings to essential elements of the page such as page size, orientation and margins. To apply Page formatting effects follow the steps given below:

1. Click **Format → Page.** The **Page Style Default dialog box** is displayed (Fig. 8.21).

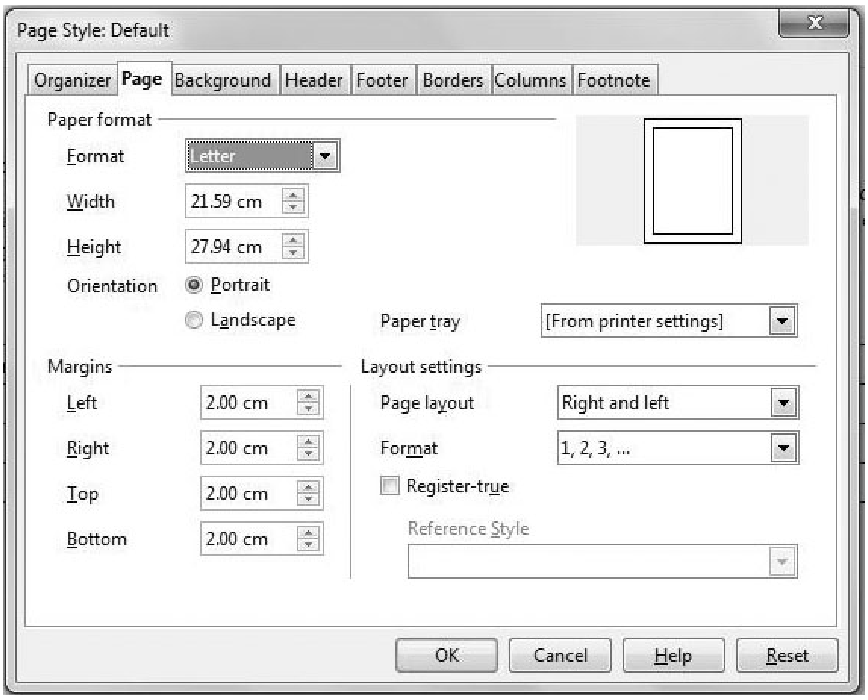


Fig. 8.21: Page Style Default dialog box

Notes

2. Select the **Page** tab and in the **Paper Format** section:

   (a) Select the required page size from the **Format List box**.

   (b) Select the **Orientation** by selecting either Portrait or Landscape radio buttons.

The Properties Toolbar on the extreme right of the Writer window contains various commands to apply character, paragraph and page formatting to the document .

3. From the **Margins** section, set top, bottom, left and right margins of the page.
4. Click **OK** button to apply the selected Page formatting effects.

In the Writer window, click and drag the margin indicators on the rulers to set the page margins.

INTEXT QUESTIONS 8.1

1. Define Word Processor. Name any two word processors.
2. Fill in the blanks.

   a. To view the document before printing, click .... option from the File menu.

   b. The case in which first letter of the sentence is capitalized is called ....

   c. The Find and Replace option is in .... menu.

   d. The shortcut key to select the text in a paragraph from the cursor position to the end of the paragraph is ....

   e. The vertical blinking line in the work area whose location determines where the next character will be inserted is called ....

3. Multiple Choice Questions

   (i) Which of the following is the shortcut key to save the document for the first time in Writer?

   (a) Ctrl + S (b) Shift +S

   (c) Ctrl + Shift +S (d) None of the Above

   (ii) Which of the following is **not** the type of formatting in Writer?

   (a) Character (b) Line

   (c) Paragraph (d) Page

Notes

(iii) Using which of the following methods can you open the Find & Replace dialog box?

(a) Pressing Ctrl + F (b) Select Format → Find & Replace

(c) Both (a) and (b) (d) Neither (a) nor (b)

8.11 HEADERS AND FOOTERS

In multipage documents, you may need to put some additional information like page numbers, author's name, date of creation of the document etc. on the top or bottom of the page. Such information inserted at the top of the page is called header and that inserted at the bottom of the page is called footer. To insert header or footer in the document, follow the steps given below:

1. Click **Insert → Header/Footer → Default.**
2. The cursor appears in the Header/Footer section of the document. Type the desired text in the Header/Footer. In Fig. 8.22, the text 'National Institute of Open Schooling' is inserted as a header.

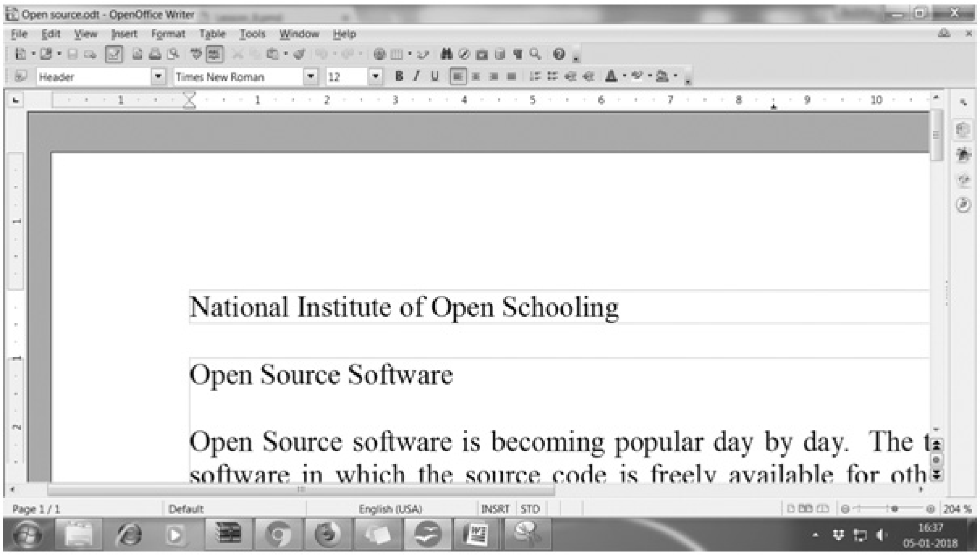
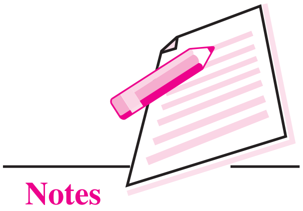


Fig. 8.22: Document with Header

8.12 INSERTING PAGE NUMBERS

To insert page numbers, position your cursor at the place where page number has to be inserted. It may be in the main document or in the header or footer area. Select **Insert → Fields → Page Number** (Fig. 8.23).



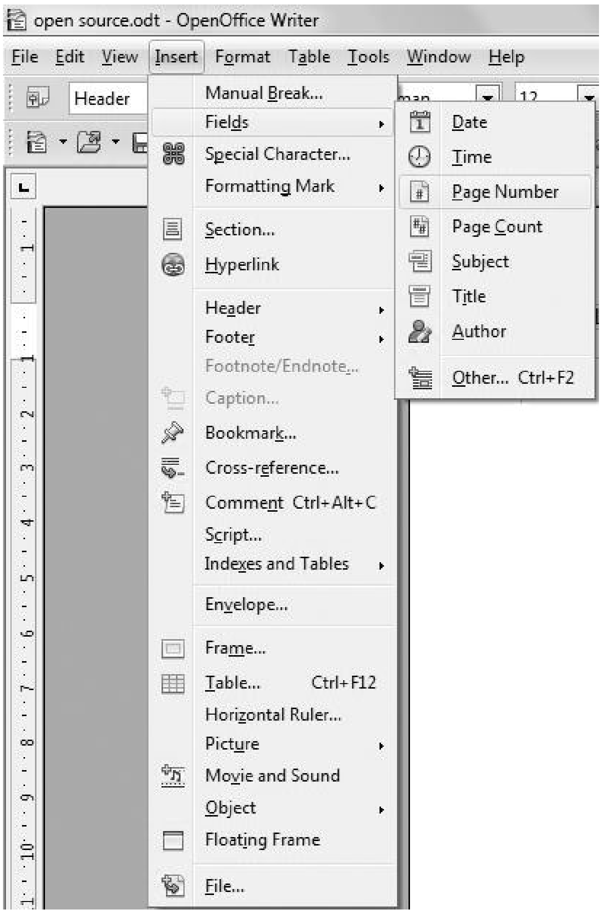


Fig. 8.23: Insert Page Number option

8.13 INSERTING SPECIAL CHARACTERS

To insert special characters in the document, follow the steps given below:

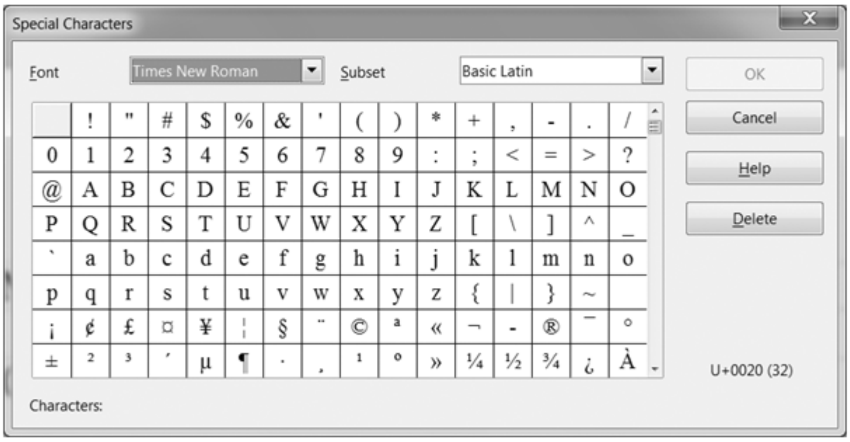


Fig. 8.24: Special Characters dialog box

Notes

1. Place the cursor at the place where the special character has to be inserted.
2. Select **Insert → Special character**. The **Special Character dialog box** is displayed (Fig. 8.24).
3. Click on the desired symbol and then click **OK** button. The selected symbol will be inserted in your document.

8.14 BULLETS AND NUMBERING

Bullets and Numbering feature of OpenOffice Writer helps us to present the information in the form of lists. The bulleted list contains various styles of bullets like circles, squares, arrows etc. while the numbered list contains alphabets and numbers. To use the Bullets and Numbering feature, follow the steps given below:

1. Select the paragraph or text to which the bullets have to be applied. If the text is not typed, place the cursor at the position from where you want to start the list.

2. Click **Format → Bullets and Numbering**. The Bullets and Numbering dialog box appears (Fig. 8.25).

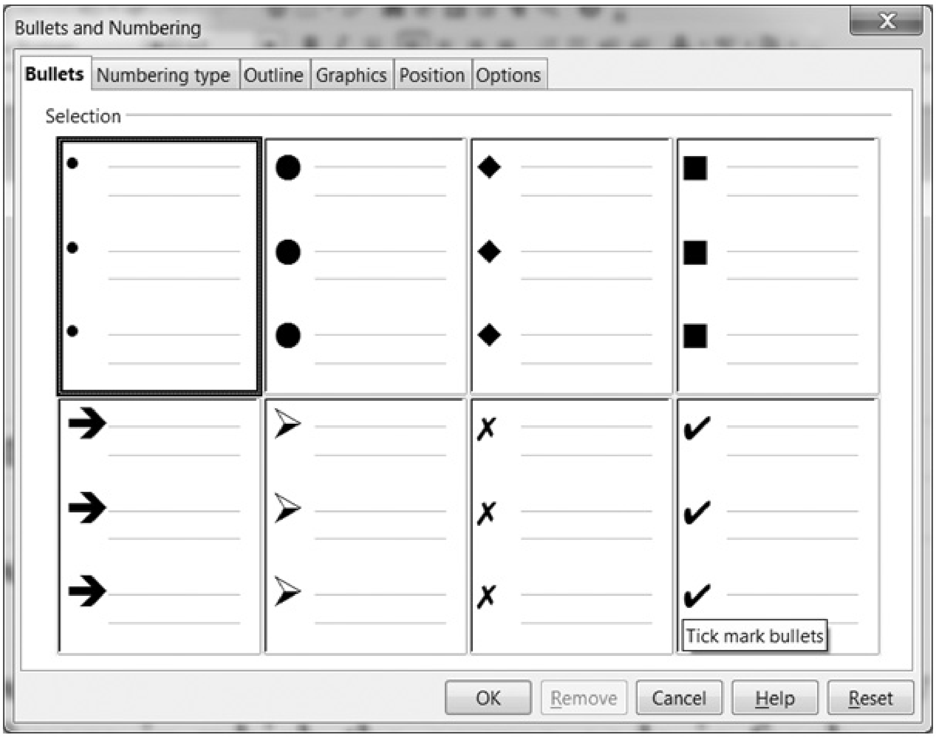


Fig. 8.25: Bullets and Numbering dialog box

3. By default, the **Bullets** tab is selected. Select the desired bullet style. Otherwise click the **Numbering Type** tab and select the desired numbering style.

4. Click **OK** button. The bullet/numbering style will appear in the document.

8.15 SPELLING AND GRAMMAR CHECK

Using Spelling and Grammar Check feature of Writer, we can find and correct spelling and grammatical errors in our document easily. It even allows us to create personal and custom dictionaries to store words that are not available in the built-in dictionaries. The two ways of checking Spelling and Grammar in Writer are:

8.15.1 Auto Spell Check

This feature, when activated, automatically underlines possible spelling mistakes with a red wavy line. Click **Auto Spell Check** button ( ) on the Standard toolbar to activate this feature. If you right click on the underlined word, Writer gives possible suggestions to select from. Just click on the spelling that you feel is correct to replace the misspelt word. In Fig. 8.26, the word 'vendor' is wrongly spelt as 'vendr' and hence is shown with a red wavy line. The Fig. 8.26 shows the possible suggestions to correct it.

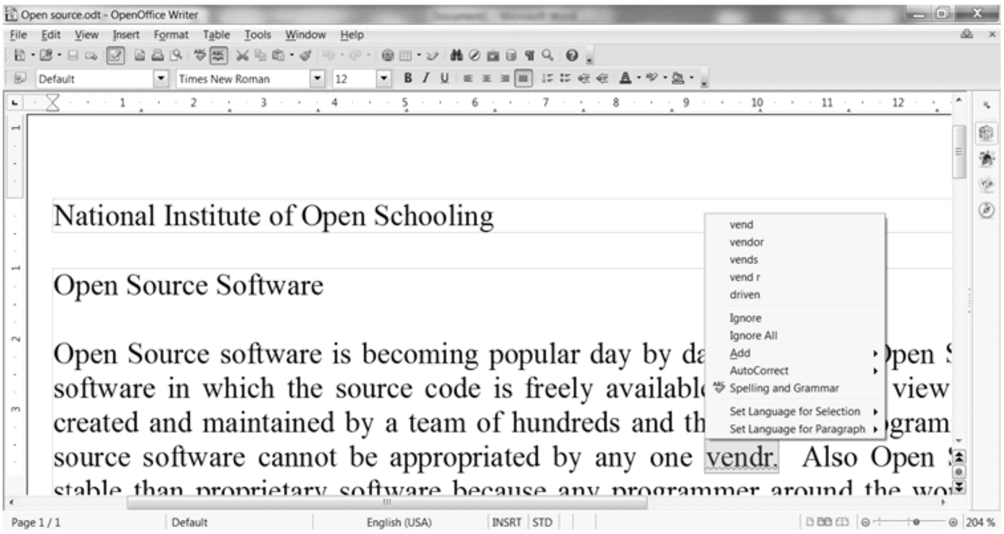


Fig. 8.26: Suggestions for correction

To add the misspelled word to Writer's standard dictionary, click the **Add → standard.dic** option from the drop down menu as shown. If **AutoCorrect** option is selected, Writer will automatically correct the misspelt word.

Notes

8.15.2 Using Spelling and Grammar option

To use this method of checking spelling and grammar in your document, follow the steps given below:

1. Place the cursor at the beginning of the document.
2. Click **Tools → Spelling and Grammar.**
   a. The **Spelling: English (USA) dialog box** appears (Fig. 8.27).

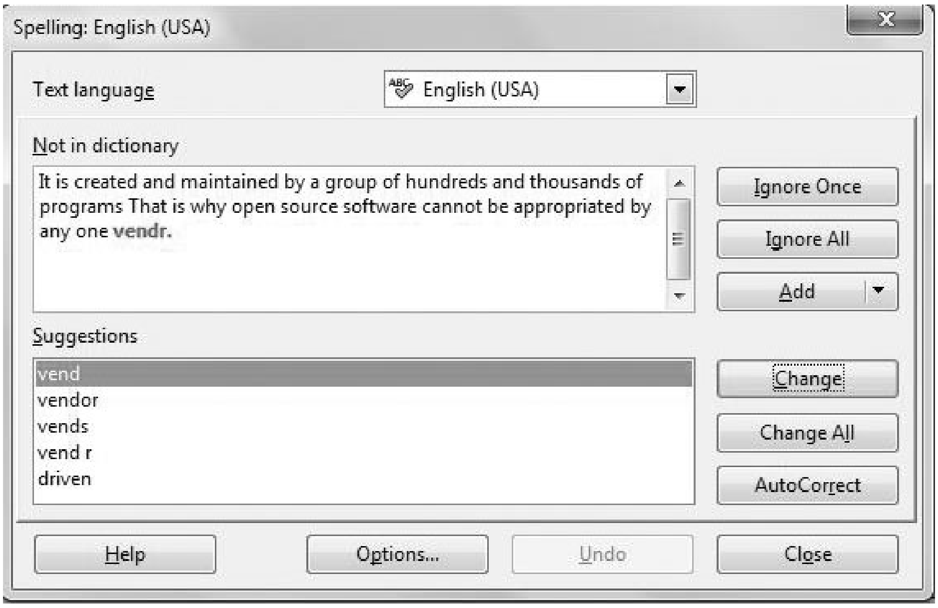


Fig. 8.27: Spelling: English(USA) dialog box

   b. The misspelt word (*vendr* in Fig 8.27) will be displayed in red colour in the '**Not in dictionary**' section. The suggestions for correction are given in the lower portion of the dialog box. Perform either of the following steps:
      i. To accept the suggested word, click the suggested word and then click **Change** button
      ii. Edit the word or phrase manually in the upper text box and then click **Change** button.
      iii. Click **Add** button to add the word in Writer's dictionary.
      iv. Click **Ignore** button if you want to ignore the spelling error indicated by Writer.

Press F7 to start the Spelling and Grammar check

   c. After all the spelling errors are removed, a message box is displayed stating that the Spelling and Grammar check is complete. Click **OK** button.
   d. Click **Close** button in the Spelling: English (USA) dialog box to close the dialog box at any time in between.

Notes

8.16 GRAPHICS IN WRITER

Graphics make the document more attractive, informative and presentable. OpenOffice Writer provides various options to add graphics in the document. We can add graphics by drawing objects and inserting pictures.

8.16.1 Drawing Objects

The Drawing toolbar contains various commands to draw lines, curves, shapes, callouts, symbols, flowcharts, graphic fonts etc. in the document. Therefore, to insert drawing objects first click **View → Toolbar → Drawing** to display the Drawing Toolbar (Fig. 8.28).

Fig. 8.28: Drawing Toolbar

Click to select any of the object and then click and drag the mouse in the work area to draw the selected object. The toolbar contains buttons for colouring, inserting patterns, borders and various other commands to enhance the appearance of drawing objects. Fig. 8.29 shows various drawing objects that have been inserted using the Drawing toolbar.

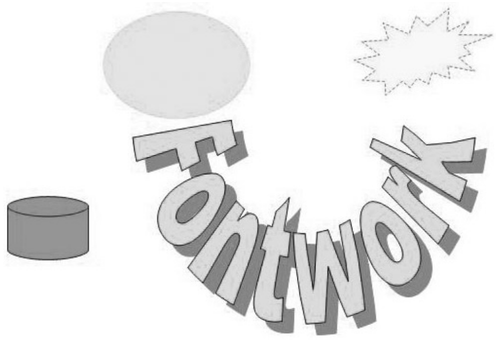


Fig. 8.29: Drawing Objects inserted in the document

8.16.2 Inserting Pictures

To insert a picture in a Writer document perform the following steps:

1. Click the **Tools → Gallery** button. The Picture gallery is displayed (Fig. 8.30).
2. The pictures are categorised according to various themes. On selecting any of the themes from the left side of the gallery, the corresponding pictures are displayed on the right side. Select the desired theme and then the desired picture.

Notes

3. Right click the picture that you want to insert and select **Insert ® Copy** from the drop down menu (Fig. 8.30).

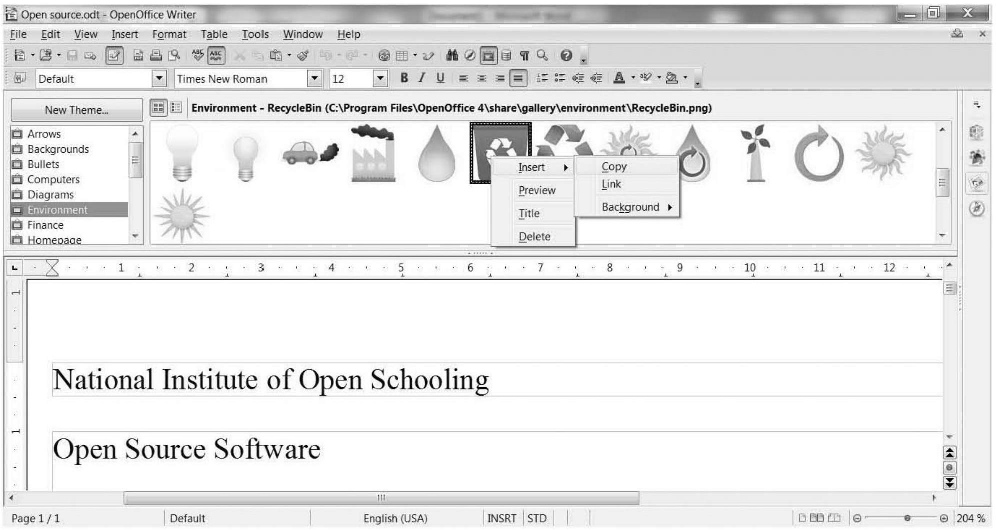


Fig. 8.30: Inserting a picture

4. The picture will be inserted in the document (Fig. 8.31). We can resize the picture by clicking and dragging the size handlers.

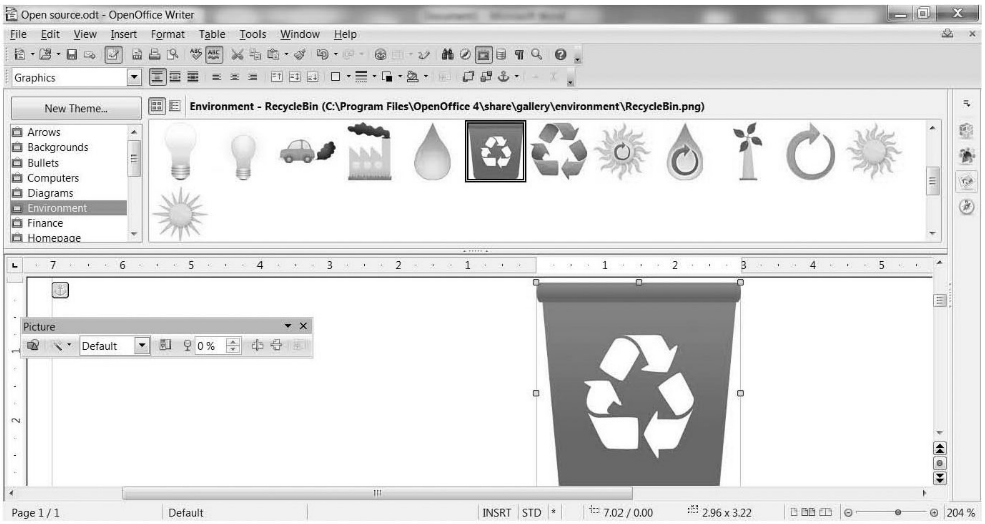


Fig. 8.31: Inserted Picture in the document

Click Gallery button ( ) on the extreme right of Writer Window to display the picture gallery (Fig. 8.31).

As the picture is inserted, the **Picture toolbar** is displayed on the screen (Fig. 8.31). The various commands on this toolbar can be used to enhance the appearance of the inserted picture.

8.17 WORKING WITH TABLES IN WRITER

A table is a grid of rows and columns. It helps to present data in row and column format. Follow the steps given below to insert a table in the document:

1. Click **Insert** → **Table**. The **Insert Table** dialog box appears (Fig. 8.32).

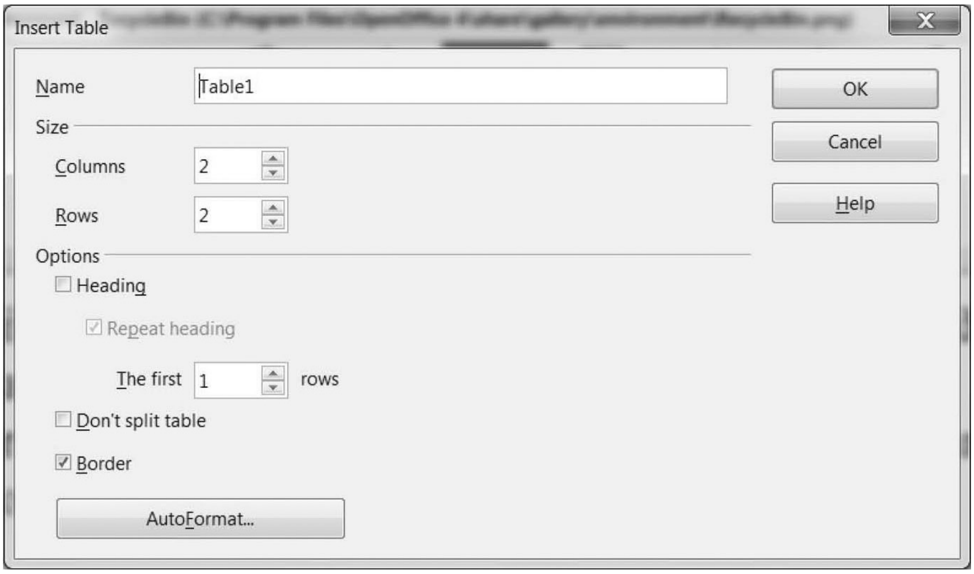


Fig. 8.32: Insert Table dialog box

2. Type the name of the table in the **Name** text box..

3. Choose the number of rows and columns from the respective list boxes.

The shortcut key to open the Insert Table dialog box is Ctrl + F12.

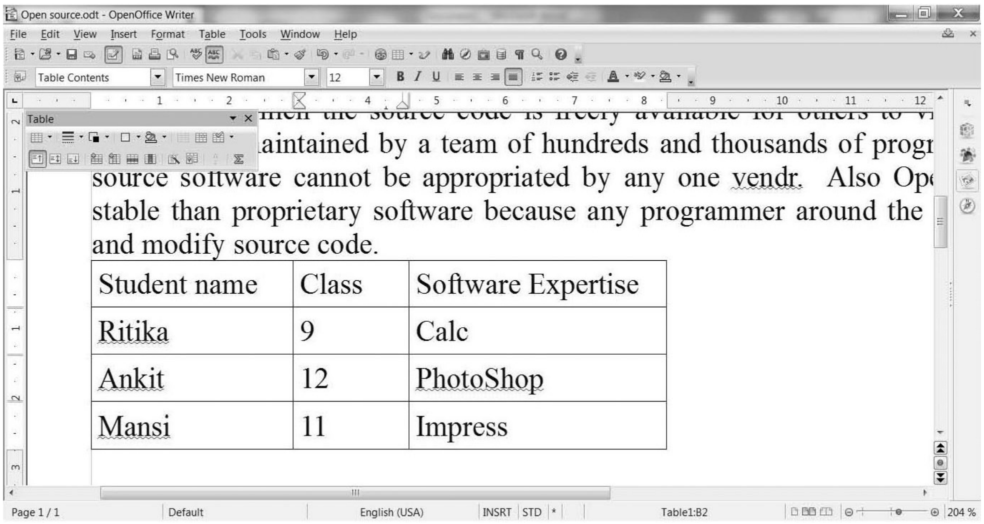


Fig. 8.33: Table inserted in the document

Notes

4. Click **OK** button. The table with specified number of rows and columns will be inserted in your document (Fig. 8.33). As the table is inserted in the document, the Table toolbar is also displayed (Fig. 8.33). This toolbar contains various commands to edit/format the table.
5. Click in any cell of the table to enter data. Other than the mouse, the following keys can be used to move in the table:

   Tab : to move one cell to the right
   Shift + Tab : to move one cell to the left
   Up Arrow: to move up by one row
   Down Arrow: to move down by one row

8.17.1 Inserting a row and column in a table

1. To insert a row or column in a table, right click the cell above which you want to insert a row or beside which you want to insert a column.
2. From the drop down menu, select the **Row** or **Column** option.
3. Select **Insert** option from the submenu.
4. The **Insert Row** or **Insert Column dialog box** is displayed (Fig. 8.34).

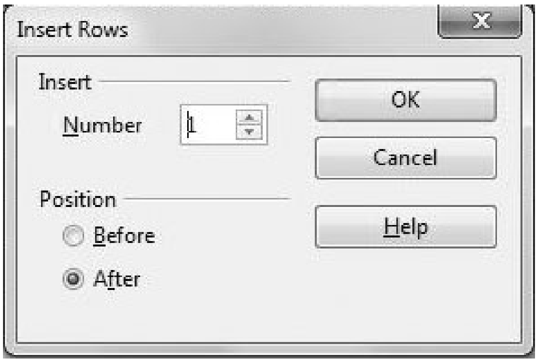


Fig. 8.34 : Insert Row dialog box

5. Choose the number of rows or number of columns to be inserted.
6. Also choose the position of the rows or columns to be inserted i.e., before or after the current cell.
7. Click **OK**. The specified number of rows/columns will be added to the table.

Click Table button ( ) on the Standard Toolbar to insert a table.

8.17.2 Deleting Row or Column from a table

1. To delete a row or column in a table, right click a cell in the row/column that you want to delete.
2. From the drop down menu, select the **Row** or **Column** option.
3. Select **Delete** option from the submenu. The selected row/column will be deleted.

8.17.3 Formatting a Table

Formatting a table means changing the appearance of the table. This can be done by applying/changing the colour of the text, cells or border or even by altering the thickness of the border. Writer allows us to automatically format the table by selecting **Table → Auto Format** option. In the **Auto Format** dialog box (Fig. 8.35) that appears, set the desired format and click **OK** button.

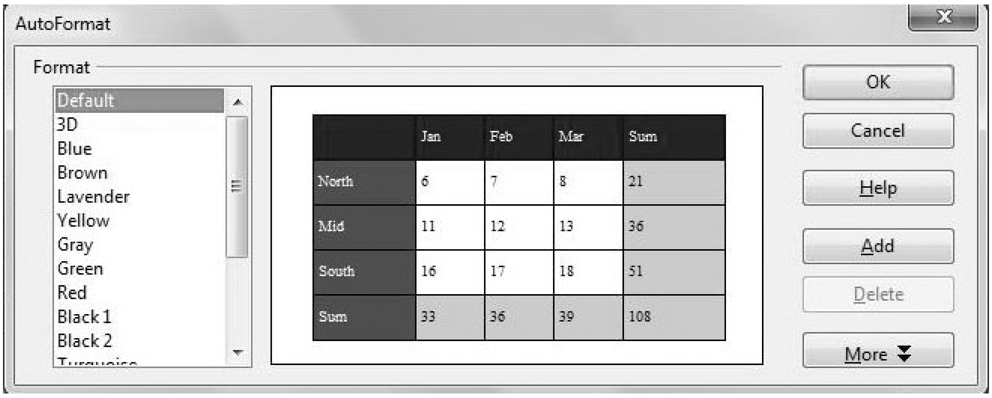


Fig. 8.35: AutoFormat dialog box

8.18 TRACK CHANGES

Sometimes, our document may be used and edited by multiple users. To track or record the changes made by each user, Writer provides the Track Changes feature. When this feature is enabled in the document, we can view all the previous versions of the document. This is because Writer keeps track of all types of changes that have been made by any user in the document. Perform the following steps to use the Track Changes feature in the document:

1. Click **Edit → Changes → Record**. This enables the process of recording changes in the document. Now, whatever modifications are made to the document, will appear as coloured text.

2. Make some changes in the document, say inserting or deleting any text or applying some formatting effects. In the example shown in Fig. 8.36, the word ‘appropriated’ has been deleted and the word ‘owned’ has been added.

3. The inserted text will be displayed in different colour. The deleted text is also displayed in a different colour and also gets striked through. Also when we keep the mouse pointer on the changed text, a tooltip showing the name of the user who has made the change along with date and time of making the change is displayed.

Notes

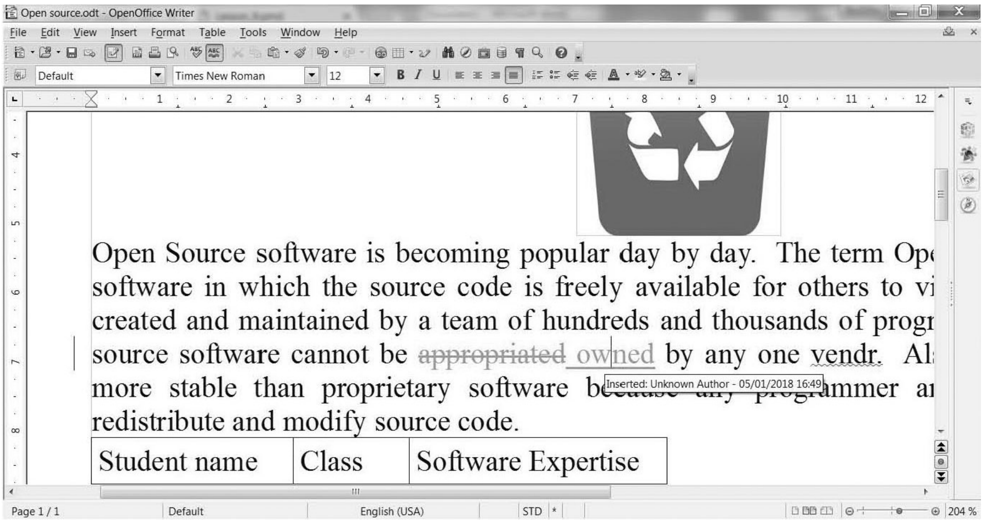


Fig. 8.36: Recording the changes

8.19 MAIL MERGE

Mail Merge is a feature that helps to generate personalized letters, memos, labels etc. This feature is helpful when similar information has to be sent to large number of people. The text (for example, name, address, etc.) from a single data source is combined with another document containing the main content. This feature saves lot of time as there is no need to type separate letter for each recipient. We can also produce labels or envelopes containing names and addresses of different persons in one go.

The three main components of Mail Merge feature are:

(i) **Data Source:** This refers to the database that generally stores the names, addresses and other personalized information in tabular format.

(ii) **Main Text document:** This contains the main body of the letter.

(iii) **Merged Document:** This refers to the document that is generated after merging the information of the main text document and the data source.

Let us now create a document using Mail Merge feature of OpenOffice Writer. It broadly consists of two steps – Creating a data source and merging the document with the data source

STEP I: Creating a data source

1. Select **File → New → Database** as shown in the figure. The database wizard starts (Fig. 8.37).

Fig. 8.37: Starting Database Wizard

2. Select **Create New Database** option and click **Next** button.

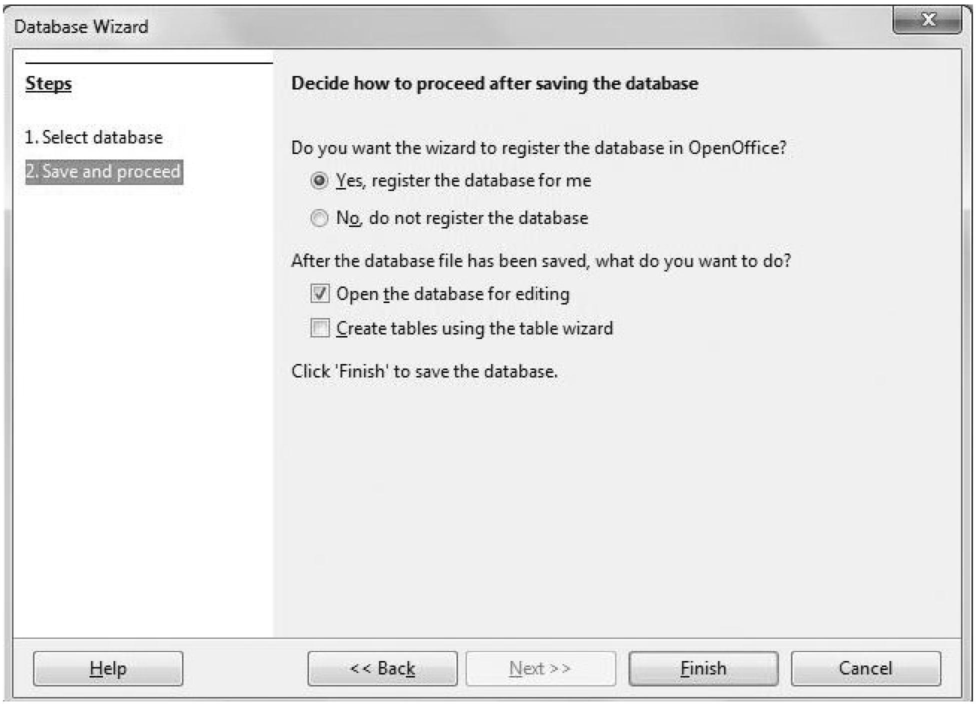


Fig. 8.38: Finish button

3. Click **Finish** button (Fig. 8.38). This finishes the process of creating a database. The **Save As** dialog box appears.

Notes

4. Type the name of the database (db1, in our example) in the **Name text box**. Also specify the location where you want to save the database and then click **Save** button. By default, the database is saved with an extension .odb. The new database window appears and the **Tables** option in the **Database pane** is automatically selected (Fig. 8.39).

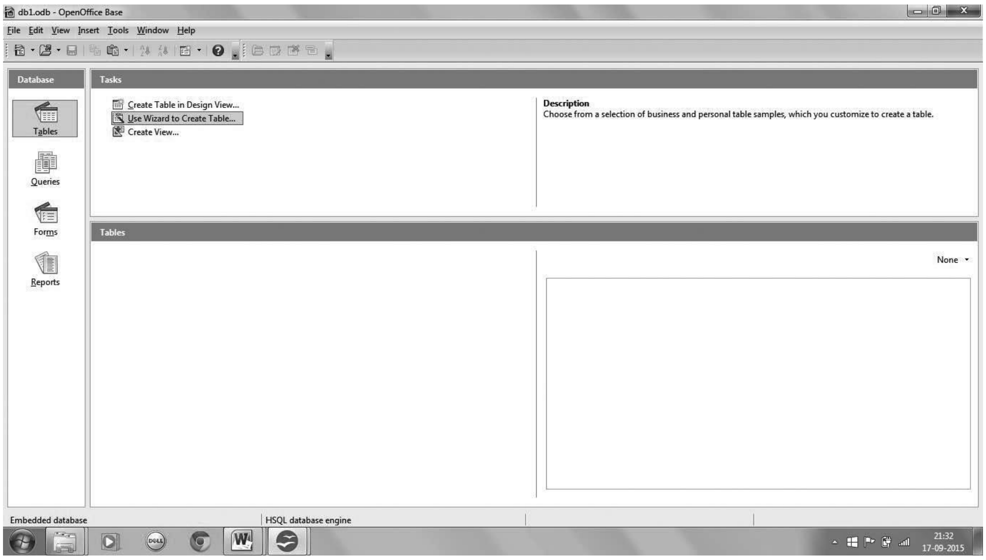


Fig. 8.39: New Database Window

5. In **Tasks** pane, select the **Use Wizard to Create Tables** option. The Table Wizard starts (Fig. 8.40). Notice that there are two panes in the Table Wizard dialog box, on the left is of **Steps** and on the right are the tasks associated with each step. The first step is **Select Fields** that is selected in the Steps pane. On the right pane, it asks to **Select Fields for your table**.

Fig. 8.40: Step 1- Select Fields

Notes

6. Select the **Category** for your table. In our case we select *Personal*.
7. Select the desired table (*say, Authors*) from the **Sample Tables** list box.
8. Select the required fields from the **Available Fields list box**. To select a field, click the field and then click **>** button. In our example, we have selected *AuthorId, FirstName and LastName*.
9. Click **Next** button. The second step **Set Types and Formats** gets activated (Fig. 8.41).

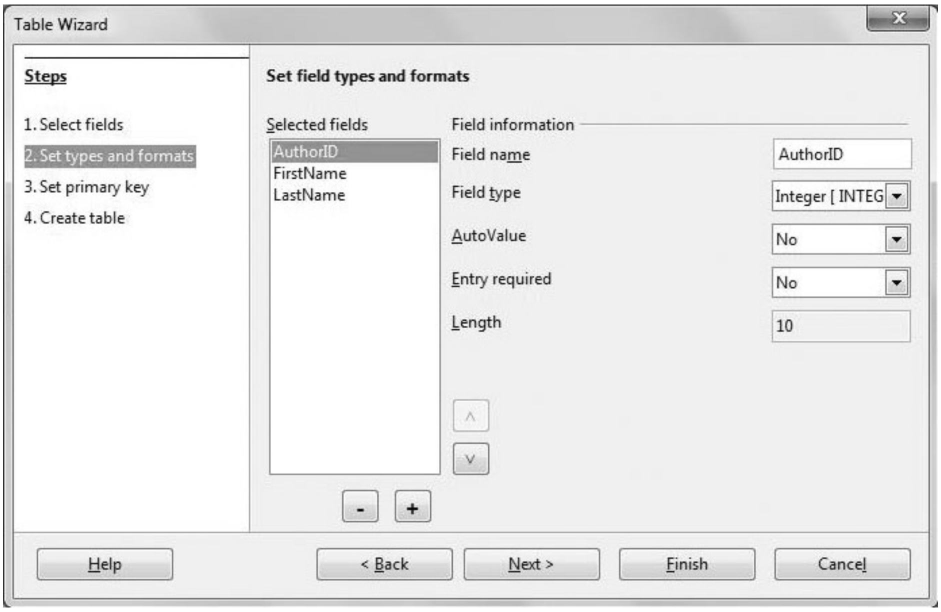


Fig. 8.41: Step 2-Set Types and Formats

10. Click **Next** button. The **Set Primary key** page appears (Fig. 8.42).

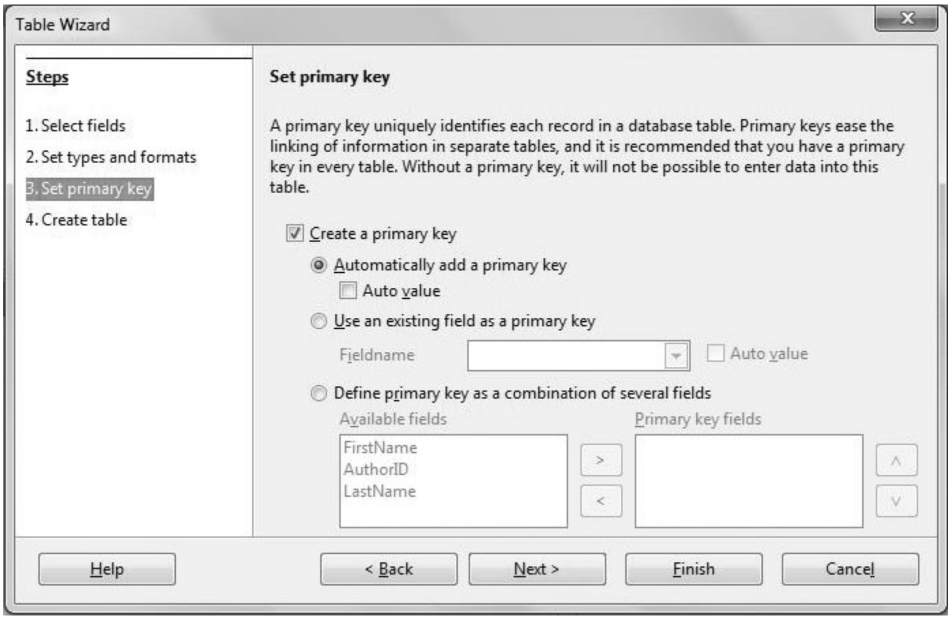


Fig. 8.42: Step 3-Setting Primary Key

11. Click **Next** button. The **Create Table Page** appears (Fig. 8.43).

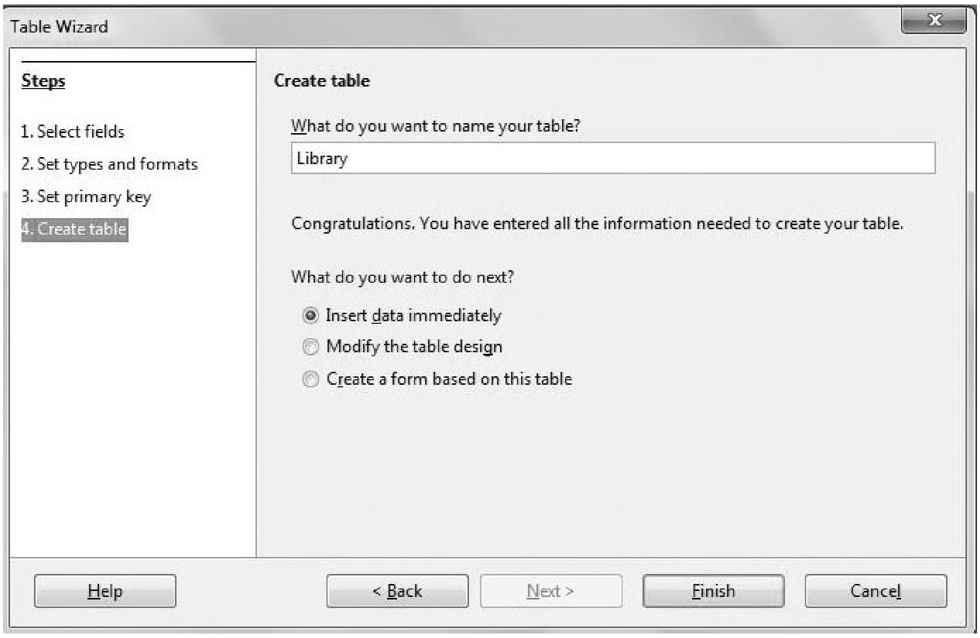


Fig. 8.43: Step 4-Create Table page

12. Type the table name in **What do you want to name your table?** text box. We have named it as *Library*.

13. Click **Finish** button. The new **Table Data View window** opens. Add few records in respective fields of your table as shown in the Fig. 8.44.

14. After entering the entire data press **Ctrl + S** to save the table then close the Table Data view window. Now your data source is ready to be merged in the main document.

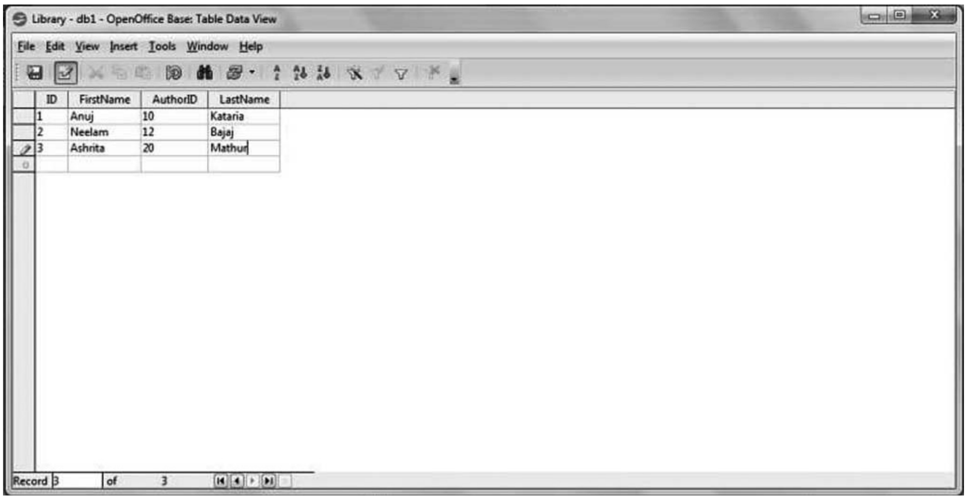


Fig. 8.44: Table Data View window

Notes

STEP II: Merging the document with data source

After creating the data source, let us now create the main document, which contains the text that is same for all recipients and also personalized information for each recipient. The steps are as follows:

1. Open Blank Document in Writer and type the required text.
2. Click **Insert → Fields → Other** option to insert fields in the main document. The **Fields dialog box** appears (Fig. 8.45).

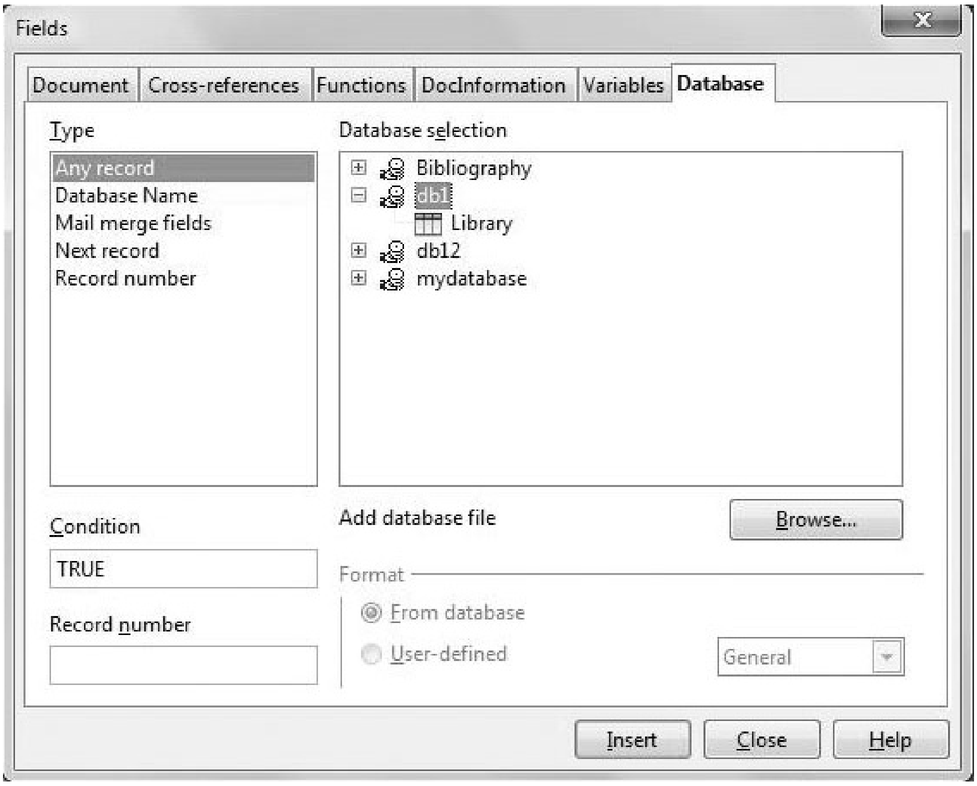
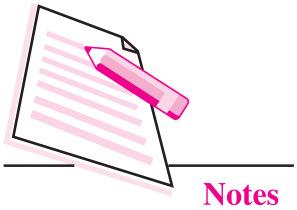


Fig. 8.45: Fields Dialog box

3. Select **Database** tab from the **Fields dialog box**.
4. To view the list of tables created in our database, double click on the database name(*db1 in our example*). Select the name of the table i.e., library in our example.
5. Select **Mail Merge fields** option from the **Type pane** of the **Fields dialog box**.
6. Click **Close** button. We will be back in the main document.
7. In the main document click **Data Source button** ( ) on the Standard toolbar. The data source with the table containing records is displayed above the main document (Fig. 8.46).



Notes

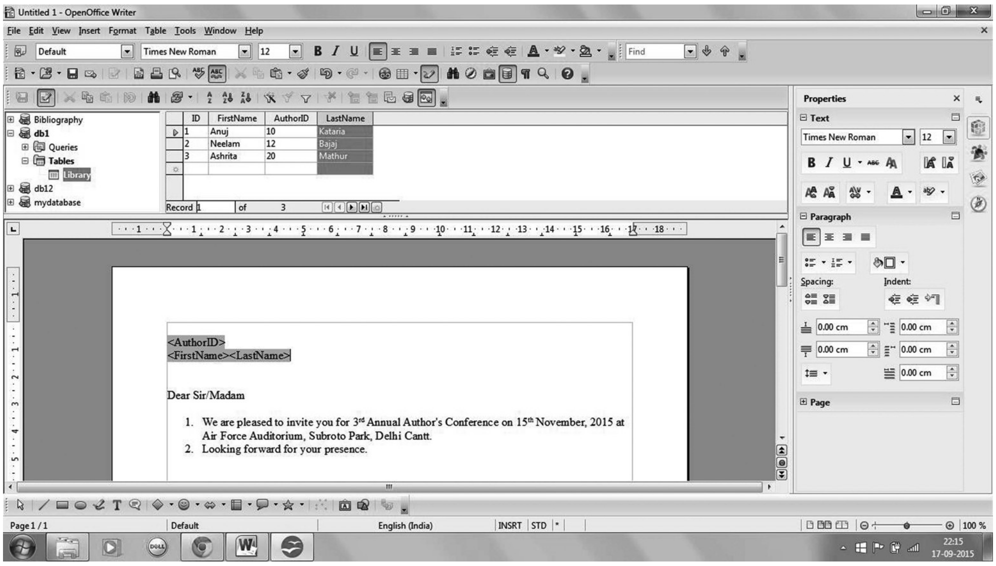


Fig. 8.46: Data Source above the main document

8. Drag the fields from the Data Source to the desired location in the main document.

9. Select **Tools → Mail Merge Wizard**. The **Mail Merge wizard** starts (Fig. 8.47). The Steps pane on the left side of the wizard displays the eight steps to be followed for Mail Merge. The right side of the wizard displays the actions to be performed in each step. The first step is to **Select Starting document**. On the right side, 'Use the current document' option is selected.

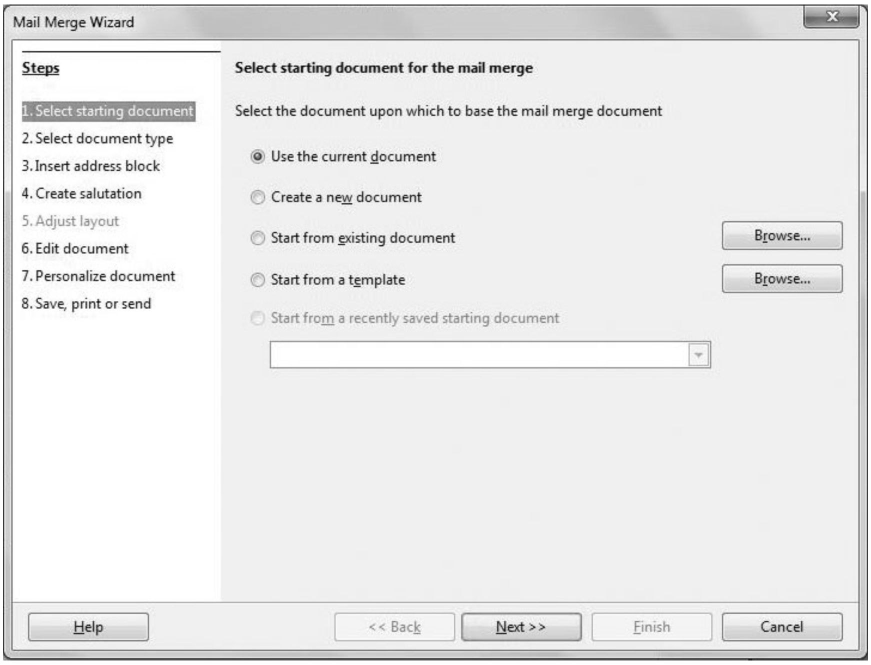


Fig. 8.47: Mail Merge Wizard (first step)

10. Click **Next** button.

11. Select the type of document (Fig. 8.48) and click **Next** button.

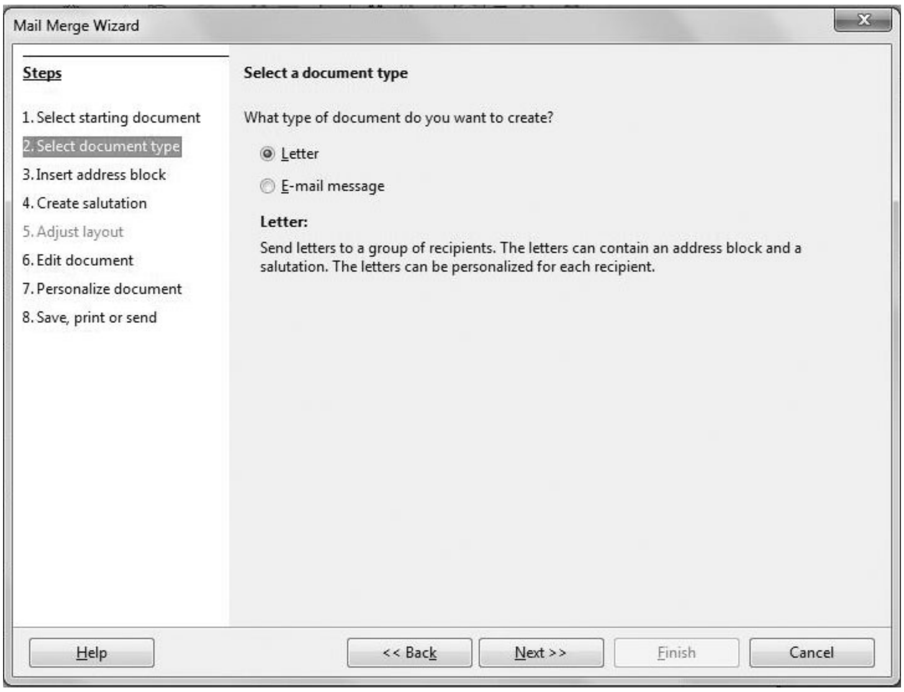


Fig. 8.48: Selecting the document type

12. If you want to select an address list, click **Select Different Address List button** otherwise click **Next** button (Fig. 8.49).

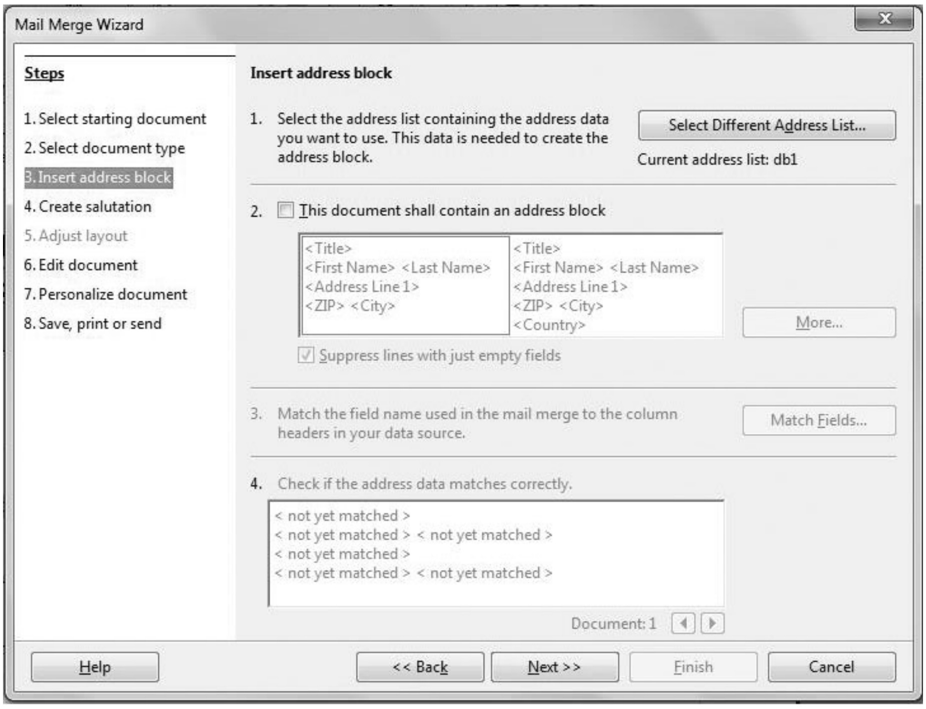


Fig. 8.49: Selecting Address block

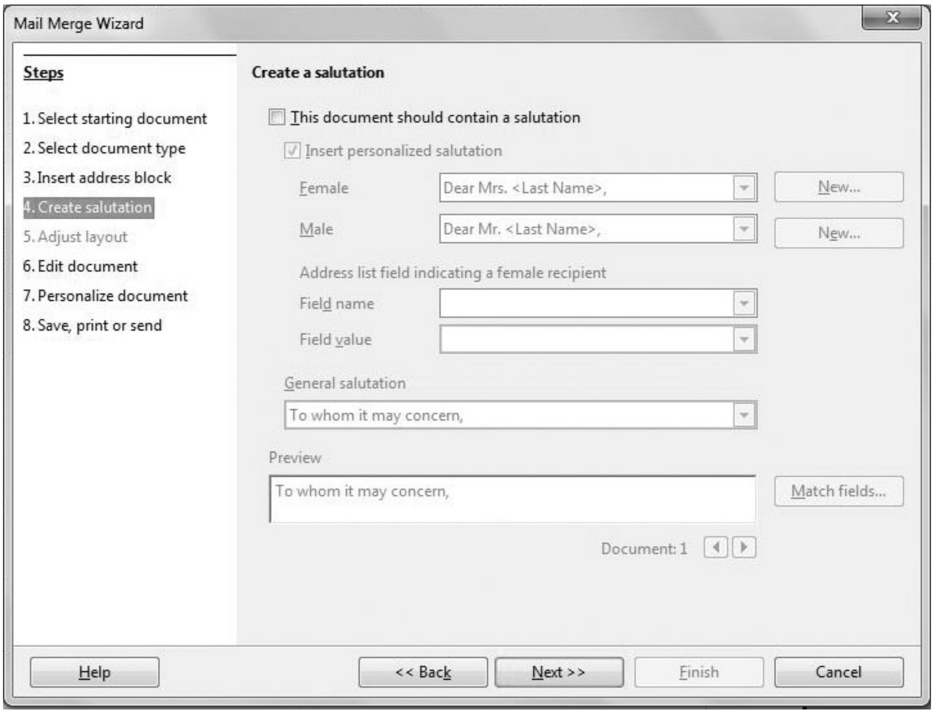


Fig. 8.50: Creating a salutation

13. Specify whether you want to create a salutation (Fig. 8.50) otherwise click **Next** button.

14. Click **Edit Document** if you want to modify the main document otherwise click **Next** button.

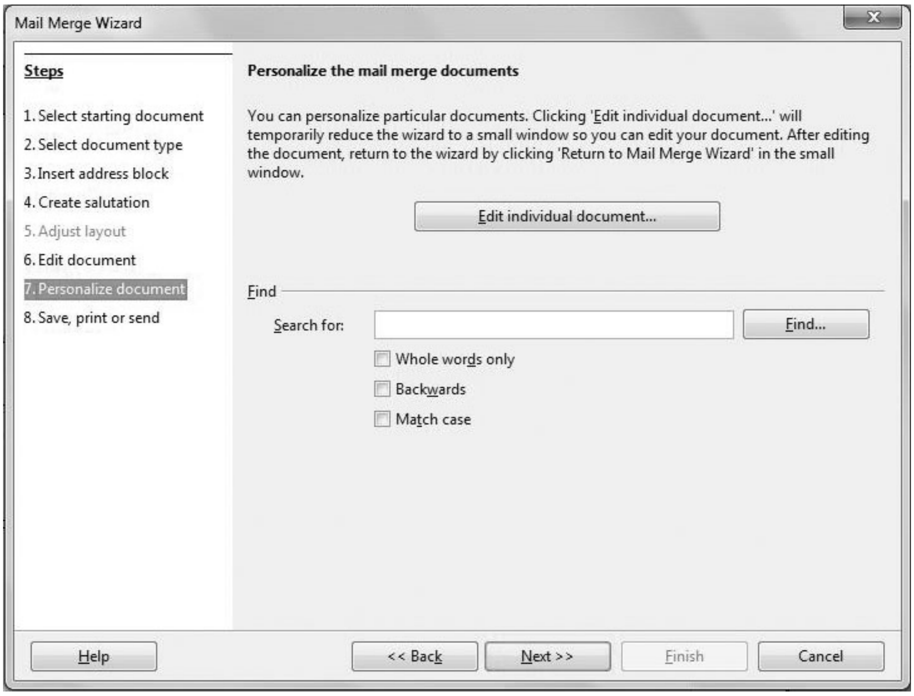


Fig. 8.51: Personalize document

15. Click **Next** button if you do not want to personalize each document.

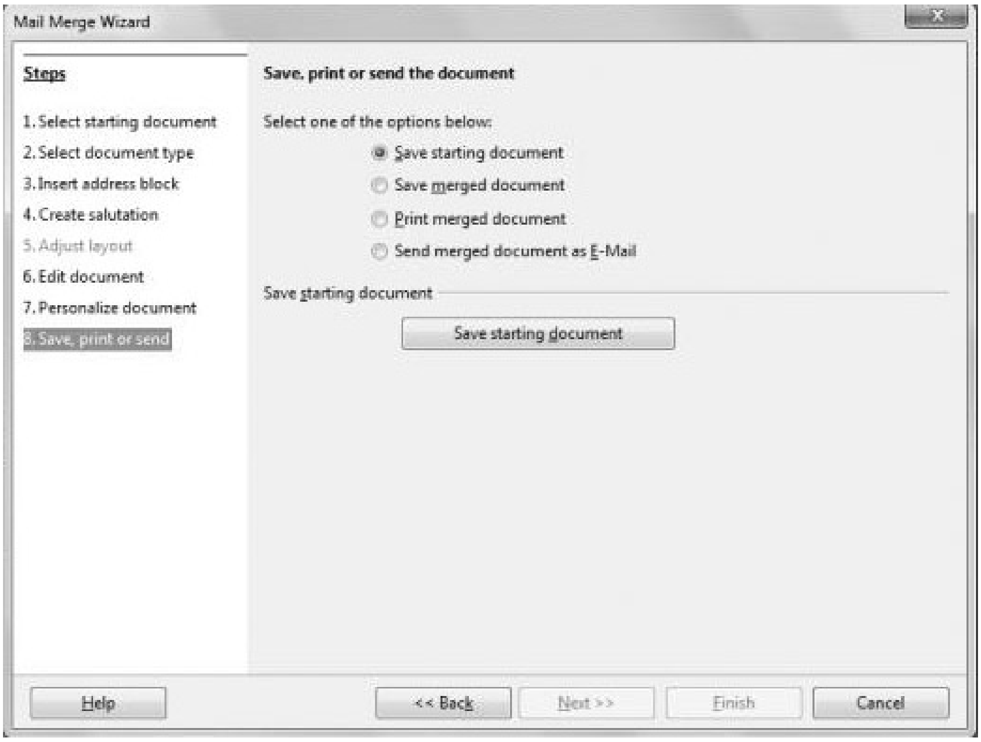


Fig. 8.52: Save, print or Send Document

16. Select whether you want to save, print or send the document to mail. Thereafter click **Save starting document** button. The **Save As** dialog box appears.

17. Specify the name and location of the merged document and click **Save** button.

18. Click **Finish** button on the Mail Merge Wizard. You will see that the merged documents are displayed.

8.20 GETTING HELP IN WRITER

Help feature of OpenOffice Writer provides us the information on various commands available in this word processing software. It lists the use and the steps to use any of the features/options seen in the Writer window.

Writer Help can be used offline as well as online. Though Writer's offline help feature is quite comprehensive, yet the online help from Openoffice.org provides some additional help materials such as tutorials, demos, quizzes etc. To use the offline help from the Writer Help window, follow the steps given below:

1. Click **Help → Openoffice.org Help**. The OpenOffice.org Help Window appears (Fig. 8.53).

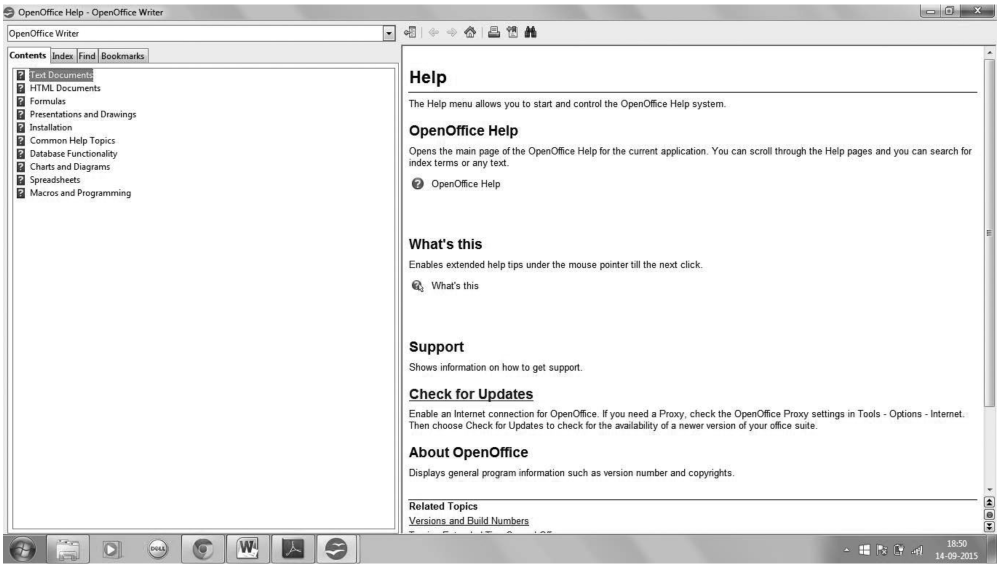


Fig. 8.53: Writer Help Window

2. Select the contents tab in the Help window. The list of contents is displayed from where we can select any topic by double clicking on it.

Press Shift+F1. The mouse pointer will change to \?. Now click on any tool in the Writer window. A tooltip containing information about that tool will be displayed.

3. If there are any subtopics, double click to select any one of these. The information related to the selected topic will be displayed.

4. Click **Close** button on top right of the Help window to exit.

Press F1 to open Writer Help window.

INTEXT QUESTIONS 8.2

1. Fill in the blanks:

   (i) The additional information inserted on the top of the page constitutes .... while that at the bottom of the page constitutes ....

   (ii) The Bullets and Numbering option is in .... menu.

   (iii) Press .... to open Writer help window.

   (iv) The Auto Spell Check button is present on the .... toolbar.

   (v) .... key(s) are pressed to move one cell to the left in a table.

Notes

2. Name the two ways in which Spelling check can be done in OpenOffice Writer.
3. Write the steps to insert a picture in your document.
4. Name the three components of Mail Merge feature in OpenOffice Writer.
5. Write the shortcut keys for the following:
   a. To open a new document
   b. To open Find & Replace dialog box
   c. To save the document for the first time
   d. To exit Writer
   e. To open Table dialog box

WHAT YOU HAVE LEARNT

- Word processor is an application software that is used for creating, editing, formatting and printing any textual data.
- Word processor has a unique feature called mail merge which allows us to send personalized letters, invitations, etc., to multiple people.
- Page formatting includes giving desired settings to essential elements of the page such as page size, orientation and margins.
- Bullets and numbering feature of OpenOffice Writer helps us to present the information in the form of lists.
- Using spelling and grammar check feature of Writer, we can find and correct spelling and grammatical errors in our document easily.
- A table is a grid of rows and columns. It helps to present data in row and column format.
- Mail merge feature helps to generate letters, memos, labels etc. It is helpful when similar information has to be sent to large number of people.

TERMINAL EXERCISE

1. Define word processing.
2. Write any three features of a word processor.
3. Differentiate between copying and moving a text.
4. What happens if you select Match Case option in the Find & Replace dialog box?
5. Name the types of cases in which text can be written in OpenOffice Writer.

6. Write the steps to insert line spacing and indentation in a paragraph.
7. Write the steps to create a numbered list in your document.
8. How can you add a word in Writer's standard dictionary?
9. Explain the Track Changes feature of OpenOffice Writer.
10. Write the steps to create a data source for using the Mail Merge feature in Writer.

ANSWERS TO INTEXT QUESTIONS

8.1

1. A word processor is an application software that is used for creating, editing, formatting and printing any type of textual data. Examples of word processor are OpenOffice Writer and MS Word

2. (a) Page Preview (b) Sentence Case (c) Edit
   (d) Ctrl+Shift+↓ (e) Cursor

3. (i) c (ii) b (iii) a

8.2

1. (i) Header, footer (ii) Format (iii) F1 (iv) Standard (v) Shift + Tab
2. AutoSpellCheck and Spelling & Grammar option in Tools menu
3. (i) Click the **Tools → Gallery** button. The Picture gallery is displayed.
   (ii) Select the desired theme and then the desired picture.
   (iii) Right click the picture that you want to insert and click **Insert → Copy** from the drop down menu.
   (iv) The picture will be inserted in the document.
4. The three main components of Mail Merge feature are:
   a. Data Source
   b. Main Text document
   c. Merged Document
5. a. Ctrl + N
   b. Ctrl + F
   c. Ctrl + Shift + S
   d. Ctrl + Q
   e. Ctrl + F12

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9

SPREADSHEETS

In the previous lesson you have learnt about digital documentation. In this lesson you will be learning OpenOffice Calc (version 4.1.1) which is the spreadsheet application that comes with OpenOffice Suite. Spreadsheet is one of the very useful application software for handling numerical data and short text strings. The data is arranged in a grid of rows and columns which can be manipulated, analysed and displayed in various formats including tables and charts. This helps us to make more informed decisions. We are able to track changes in data, write formulas to perform calculations on that data and even build models for analysing data. Various spreadsheet software available in the market are Lotus 1-2-3, MS Excel, and OpenOffice Calc.

OBJECTIVES

After reading this lesson, you will be able to:

- list applications of spreadsheets;
- explain the components of Calc application window;
- create, save, open and close a workbook;
- enter, select, edit a worksheet;
- use AutoFill feature and sort lists;
- format cell content;
- merge and wrap text in a cell;
- use formulas, functions and cell referencing;
- perform sorting and filtering of data;
- create charts;
- print the worksheets.

9.1 APPLICATIONS OF SPREADSHEETS

You know that spreadsheet is a very useful application, especially in offices where numerical data has to be stored, manipulated and analysed at regular intervals. Each page of a spreadsheet is known as a worksheet and a collection of worksheets constitutes a workbook. Some of the common applications of spreadsheets are as follows:

(i) These act like a calculator for doing automatic calculations. They are used to calculate, analyse, store and present the information.

(ii) In a spreadsheet if one value is changed, all the corresponding calculations will be re-calculated. So these are very useful in What-if analysis.

(iii) Spreadsheets are very useful to manage financial data like stock exchange movements, account transactions etc.

(iv) The data in a spreadsheet can be pictorially represented through charts.

(v) Various in-built functions help in easy processing and manipulation of data.

9.2 STARTING OPENOFFICE CALC

To start OpenOffice Calc, follow the steps given below:

1. Select **Start → All programs → OpenOffice 4.1.1**

2. Select **OpenOffice Calc** option. The Calc application window is displayed as shown in Fig. 9.1.

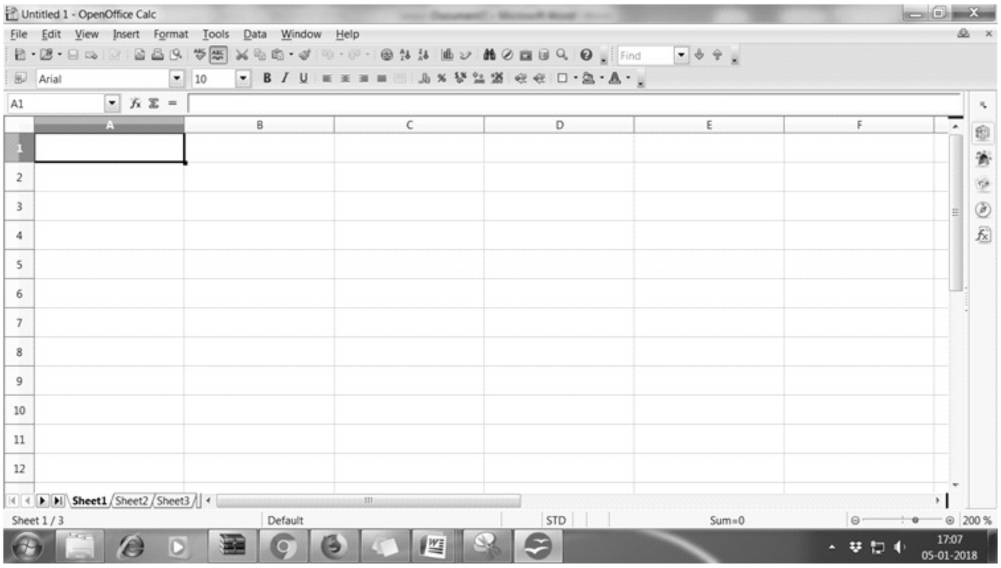


Fig. 9.1: OpenOffice Calc Application Window

9.3 COMPONENTS OF CALC APPLICATION WINDOW

Fig. 9.1 shows the components of Calc Application Window.

Title Bar: It is located on the top of the application window. It displays the name of the workbook and the name of the application. The window control buttons (Minimize, Maximize/Restore and Close) are present on the extreme right of the title bar.

Menu Bar: Below the title bar is the menu bar which contains various menu items - File, Edit, View, Insert, Format, Tools, Data, Window and Help. The menu bar gives access to basic commands used in Calc.

Standard Toolbar: Below the menu bar is the Standard toolbar which contains buttons for frequently used commands such as New, Open, Save, Print, Cut, Copy, Paste etc. This toolbar is also known as Function toolbar.

Formatting Toolbar: This toolbar consists of commands that help in formatting text and number data like font style, size, colour, bold, italic, underline, various number formats etc.

Formula Toolbar: This toolbar contains the Name box and the Formula bar.

- **Name Box:** It displays the name of selected cell or range of cells. For example, in Fig. 9.1, the name of active cell A2 is displayed in the name box.
- **Formula Bar:** It contains the content of the selected cell or the formula applied on selected cell. It is also used for editing the cell contents or the formulas in the active cell.

Rows and Columns: The entire worksheet is divided into horizontal rows and vertical columns. The rows are numbered on the left side of the worksheet as 1, 2,3…and so on. The columns are named on the top of the application window as A,B,C…and so on.

Cells: The rows and columns in a spreadsheet intersect to form the smallest unit of a worksheet i.e., a cell. Each cell has a unique address which is the combination of row number and column name. For example, the cell D10 will be formed by intersection of row number 10 and column name D.

Active Cell: It is the cell that is currently active or selected. The active cell has a thick black outline. Data is always entered in the active cell.

Sheet Tabs: The sheet tabs are present at the bottom of the worksheet. These are named as Sheet1, Sheet 2, Sheet 3 and so on. The active sheet tab indicates the current worksheet. By default, there are three worksheets in a workbook but we can add more worksheets as per our requirement.

Status Bar: This is located at the bottom of the Calc Application window and it displays information about the current worksheet.

When we place the mouse pointer over any of the buttons or icons on the toolbars, the name of the icon appears as a tooltip.

Scroll Bars: There are two scroll bars on the Writer Window:

- *Horizontal Scroll Bar:* It helps to navigate left and right of the worksheet.
- *Vertical Scroll Bar:* It helps to navigate the up and down of the worksheet.

We can click the arrows on the either side of the scroll bars to navigate through the worksheet.

Docking Toolbars: On the extreme right of the Calc window, there are five icons – Properties, Styles and Formatting, Gallery, Navigator and Functions. By clicking on any of these icons, the corresponding docking toolbar opens containing various buttons to format text, apply styles, insert pictures, navigate through the document and uses various built-in functions provided by Calc respectively.

9.4 CREATING A NEW WORKBOOK

When you start Calc, the application opens with a new workbook. However, if you want to open a new workbook when the Calc application is already running, select **File → New → Spreadsheet** (Fig. 9.2). The new workbook will be created and its name will appear on the title bar of the Calc window.

Press Ctrl + N to open a new workbook in Calc.

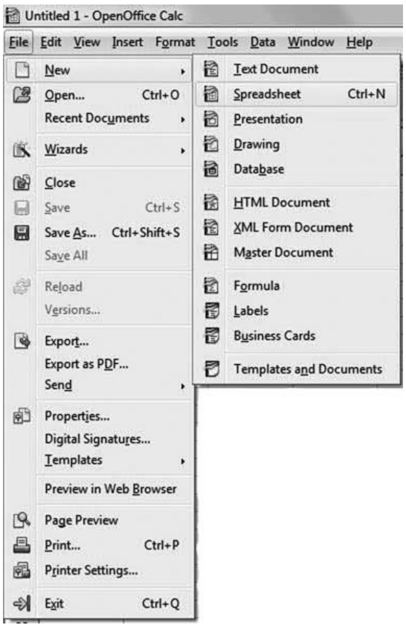


Fig. 9.2: Opening a new workbook

Notes

9.5 SAVING A WORKBOOK

To save a workbook, follow the steps given below:

1. Click **File** → **Save As**. The Save As dialog box appears (Fig. 9.3).

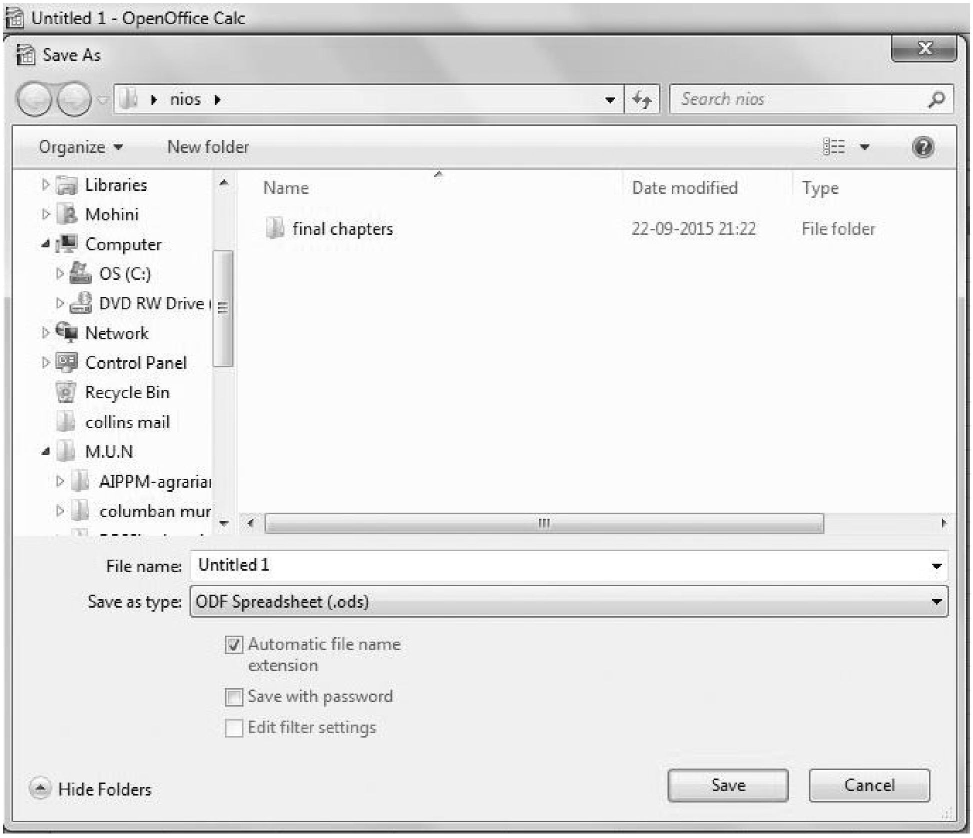


Fig. 9.3: Save as dialog box

2. Browse the folder where the file has to be saved.
3. Type the name with which the file has to be saved in the **File name** text box.
4. **Click Save** button. By default, the file created in OpenOffice Calc is saved with an extension .ods. After saving, the name of the file appears on the title bar of the Calc window.

We can also save the document by clicking on **Save** button on the Standard toolbar (Fig. 9.4). Please note that the **Save As** dialog box appears only when we are saving the file for the first time. However, if the same file has to be saved with a different name or at a different location, then select **Save As** option again from the **File** menu.

Press Ctrl + Shift + S to save document for the first time and Ctrl + S to save otherwise.

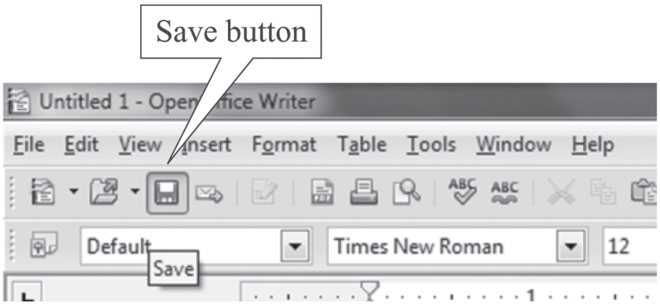


Fig. 9.4: Save button

9.6 OPENING AN EXISTING WORKBOOK

The existing file can be opened by browsing to the folder which contains the file and then double clicking on it. However, if the application is running, follow the steps given below to open an existing workbook:

Press Ctrl+O to open an existing workbook.

1. Click **File** → **Open.** The Open dialog box appears (Fig. 9.5).
2. Browse the folder where the file to be opened exists.
3. Select the file and click **Open** button.

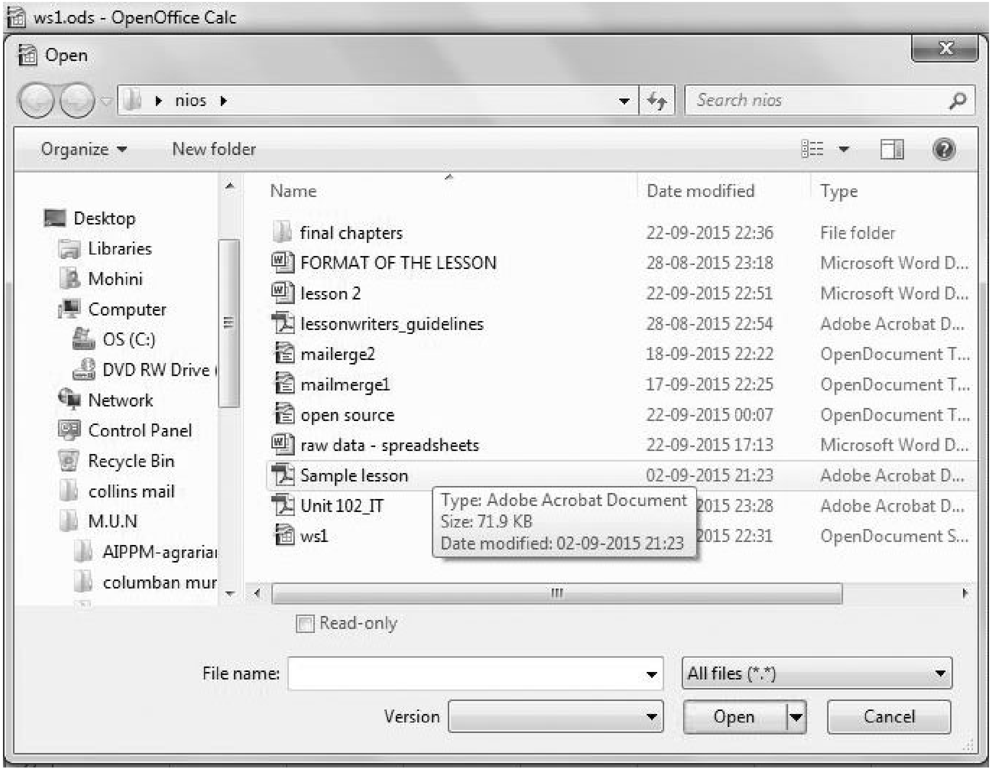


Fig. 9.5: Open dialog box

9.7 CLOSING A WORKBOOK

We can close a workbook without closing the Calc Window by selecting **File → Close**. However, to exit Calc, click **Close** button (X) on the top right corner of the Title bar or click **File → Exit** option. In either of the ways, if our document to be closed is not saved, then Writer prompts us to save the document before closing.

Press Ctrl + Q to exit Writer

INTEXT QUESTIONS 9.1

1. Give one word for the following:
   (i) The toolbar containing Save button. ____________
   (ii) Smallest unit of a spreadsheet. ____________
   (iii) The cell in which data will be entered. ____________
   (iv) Shortcut key to exit Writer. ____________
   (v) Number of scrollbars in Calc window. ____________
2. Give any three applications of spreadsheet.
3. How can you open a new workbook if Calc application is already running?

9.8 ENTERING DATA

As mentioned before, the data is entered in the cells of a worksheet. The data that we enter may be in the form of text, numbers or formulas. Entries containing an alphabet or a character even if they start with a number are called **text entries**. Any text entry containing alphabets or non-numeric special characters such as &,*,^,% etc. is called a **label**. For example, Grade, s@g, Maximum marks etc. are labels. Even numeric data in combination of alphabets and special characters like Flat # 100, Arjun Vihar form a label. These entries cannot be used in any type of calculations.

The data on which arithmetic calculations can be performed is known as **numerical data** or **value**. In addition to the numbers, characters like +, -, . , %, $(or any currency), ( ), E and can also be entered along with numerical data. The table 9.1 shows the purpose of each of the above characters:

Table 9.1: Purpose of special characters in numerical data

Character	Purpose
+	Positive number
-	Negative number
. (period)	Decimal number
( )	Enclose data in brackets
%	Percentage
$ (or any currency)	Denotes the number as a currency
E, e	Denotes Exponentiation for scientific notation of numbers

To enter labels or values, just click the cell in which the data has to be entered. The cell becomes the active cell in which the data can be typed. In Fig. 9.6, the cell A2 contains the label *Marks* and the cell A3 contains the value 67.89.

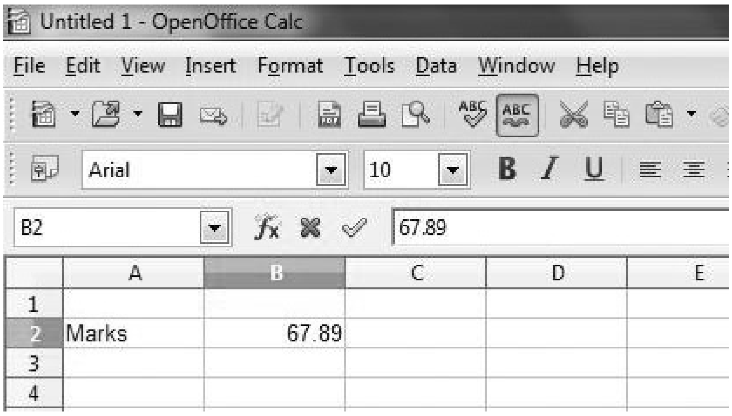


Fig. 9.6: Text and numerical data

9.8.1 Entering Formulas

Formulas are an essential part of any spreadsheet application and they generally define a relationship between two or more cells. It is a combination of values, operators, cell addresses etc. While entering a formula, we can either refer to individual cell or range of cells. They help in performing calculations and also in What–if analysis.

The formula always starts with an equal (=) sign. For example if, we want to add two numbers, say 20 and 30, we will type =20+30 in the active cell. If the data to be added is in the cells, say A2 and B2, we may also type = A2 + B2 say, in cell C2 (Fig. 9.7). In the latter method, if any of the values in either cell A2 or B2 is changed, the result in cell C2 will also change. When we type the

Notes

formula or click on the cell containing formula, we will see that the formula also appears in the formula bar.

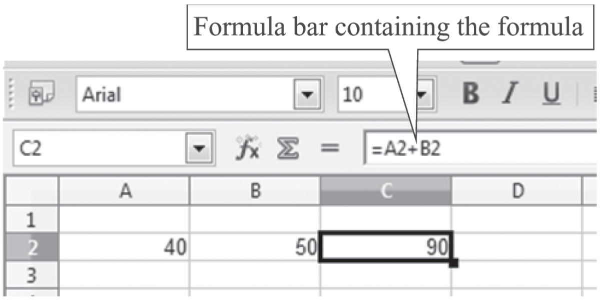


Fig. 9.7: Entering Formula

After entering the formula, if we try to edit it by clicking in the formula bar, the **Accept Editing** and **Cancel Editing** buttons on the left side of the formula bar become active (Fig. 9.8). Also notice that the colour of the cell reference and the colour of the border of the cell is same.

> *Formulas in OpenOffice Calc are not case-sensitive.*

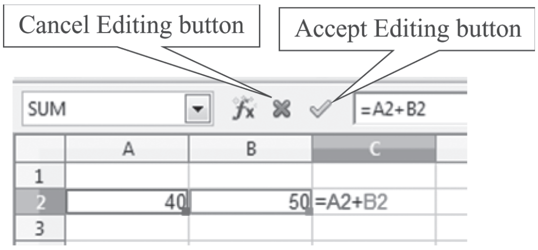


Fig. 9.8: Editing a Formula

9.9 SELECTING A CELL/RANGE OF CELLS

In OpenOffice Calc, we may require to select a single cell or a range of cells. These cells or range of cells can be selected using either a keyboard or a mouse. The selected cells are shaded in blue colour.

- To select a single cell, click on that cell. This currently selected cell is known as the **active cell** (Fig. 9.9 (a)).
- To select the entire row or column, click on the row number or column name. (Fig. 9.9 (c) & (d)).
- To select adjacent range of cells, place the mouse pointer in the first cell in the range. Thereafter click and drag the mouse pointer in the direction of selection till the last cell in the range is selected. For example, if cell range A3 to B8 has to be selected, place the mouse pointer on cell A3 (Fig. 9.9 (b)). Click and drag the mouse till cell B8. Using a keyboard, we

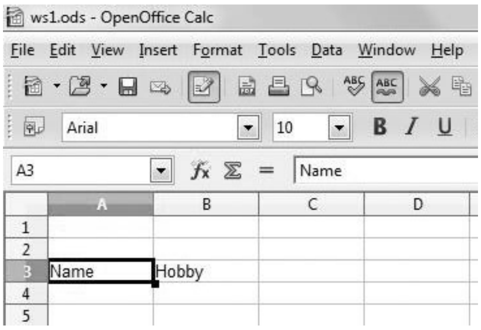
Notes

can select the first cell. Thereafter holding down the **Shift** key and using the arrow keys in the direction of selection, move to the diagonally opposite corner of cell B8. Once the last cell in the range is selected, release the **Shift** key.

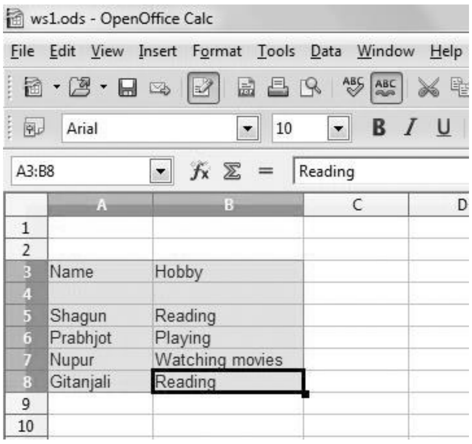
Press Shift + Spacebar to select all columns in current row.

Press Ctrl + Shift + Spacebar to select current column completely.

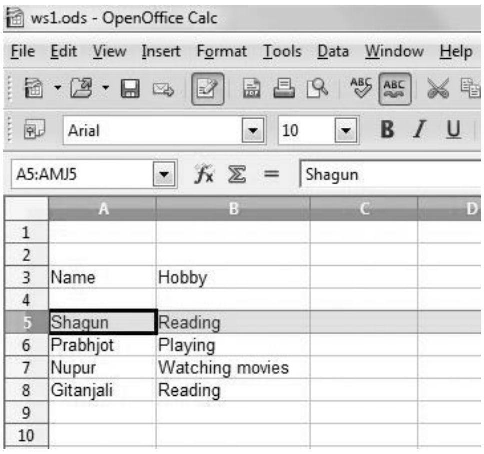
Press Ctrl + A to select the entire worksheet.



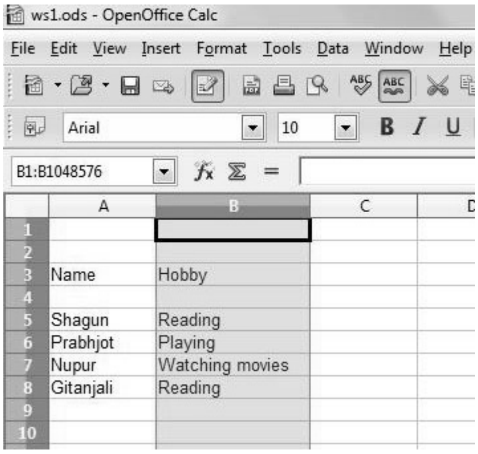
(a) Active Cell



(b) Range of selected cells



(c) Selecting the entire row



(d) Selecting entire column

Fig. 9.9: Selection of Cells

9.10 EDITING A WORKSHEET

Editing includes changing data by any means. It may be altering, inserting, deleting, copying, moving, changing appearance of the data and so on. The data once entered in the worksheet can be modified by any of the following methods:

Notes

(i) Overwriting

This is the default mode of editing cell contents in which the current content of the cell is replaced by the new one. For this, select the cell, type the new content and press the **Enter** key or click **Accept** button ( ) near the formula bar.

(ii) Partial Modification

This method is used if there are minor modifications to be done in the cell contents. Click the **Formula bar** or double click on the cell where modification is to be done. The cursor will appear. Enter the contents either in the formula bar, if you clicked the formula bar or in the cell, if you double clicked on the cell. Thereafter, press the **Enter** key or click the **Accept** ( ) button on the Formula bar.

9.10.1 Deleting Cell Content

To delete the cell contents in OpenOffice Calc, follow the steps given below:

1. Select the cell or range of cells whose contents are to be deleted.
2. Right click on the selected cells and click **Delete Contents** from the shortcut menu (Fig. 9.10). The **Delete Contents** dialog box will be displayed (Fig. 9.11).

The shortcut key to edit the cell contents is F2.

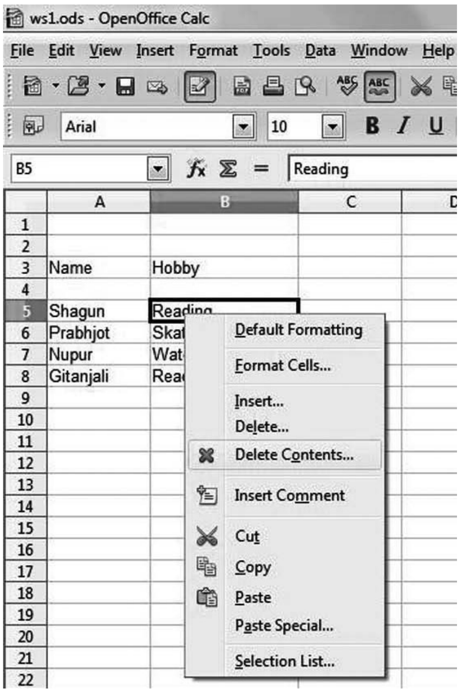


Fig. 9.10: Delete Contents option

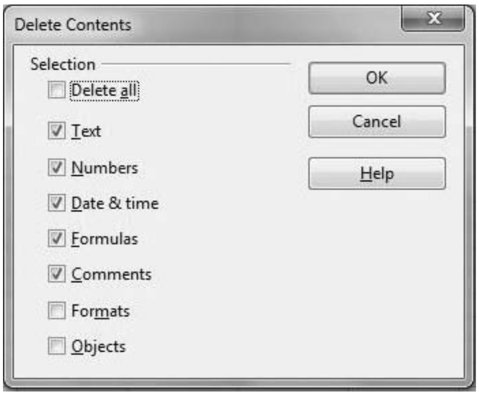


Fig. 9.11: Delete Contents dialog box

Notes

3. The various options available in **Delete Contents** dialog box are:

- *Delete All* : Deletes all the contents from selected range of cells.
- *Text*: Deletes only text from the selected range of cells, keeping all the other values.
- *Numbers:* Deletes only numbers from the selected range of cells.
- *Date & time:* Deletes only date and time values.
- *Formulas:* Deletes only formulas, keeping all the other values as it is.
- *Comments:* Deletes any notes or comments in the selected range.
- *Formats:* Deletes formatting styles applied to cells.
- *Objects:* Deletes only objects.

After clicking the appropriate checkboxes, click **OK** to delete the selected cells.

9.10.2 Copying Cell Content

The data when copied, is duplicated and pasted at a new location. To copy data, follow the steps given below:

1. Select the cell or range of cells whose data needs to be copied.

2. Click **Copy** button on the standard toolbar (Fig. 9.12). Alternatively, we can right click and select **Copy** option from the short cut menu.

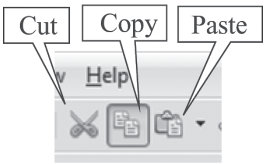


Fig. 9.12: Cut, Copy & Paste buttons

3. Click on the cell where the data has to be pasted or on the starting point where the data is to be pasted.

4. Click **Paste** button on the standard toolbar. Alternatively we may right click and select **Paste** option from the shortcut menu.

   Fig. 9.13 shows that the data is copied from A1: E4 and pasted at A10 : E13.

9.10.3 Moving Cell Content

When we move cell contents, they are removed (or cut) from the original location and pasted at a new location. Hence, unlike copying, the cell contents are not duplicated. Follow the steps given below to move data from one location to another:

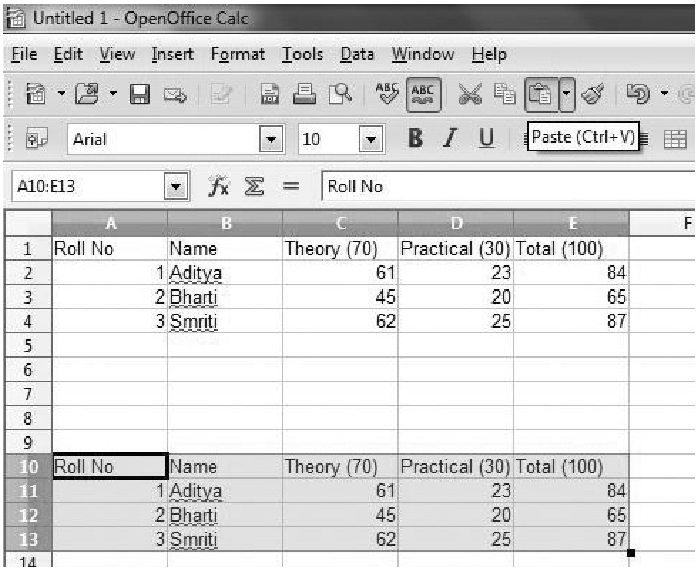


Fig. 9.13: Copying Cell contents

1. Select the cells whose data needs to be moved.
2. Click **Cut** button on the standard toolbar. Alternatively you can right click and select **Cut** from the shortcut menu.
3. Click on the cell that will be the starting point of the data when it is pasted i.e., on the upper left cell of the range where you want to copy the data.
4. Click **Paste** button on the standard toolbar. Alternatively we may right click and select **Paste** option from the shortcut menu.

   Fig. 9.14 below shows that the data is moved from A1: E4 and pasted at A10 : E13.

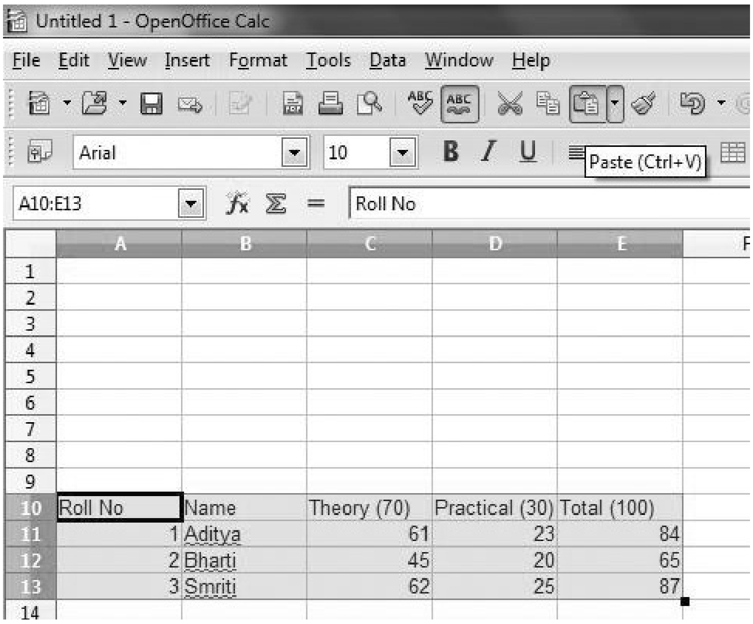


Fig. 9.14: Moving Data

9.10.4 Inserting Cells/Rows/Columns

We may have to insert cells, rows or columns in an already existing worksheet. To do so, follow the steps given below:

Select the cells and press Ctrl + C to copy, Ctrl + X to Cut and Ctrl + V to paste.

1. Select the cell or range of cells where you want to insert new cell, row or column.
2. Right click and choose **Insert…**option from the shortcut menu (Fig. 9.15).
3. The **Insert Cells** dialog box is displayed (Fig. 9.16).

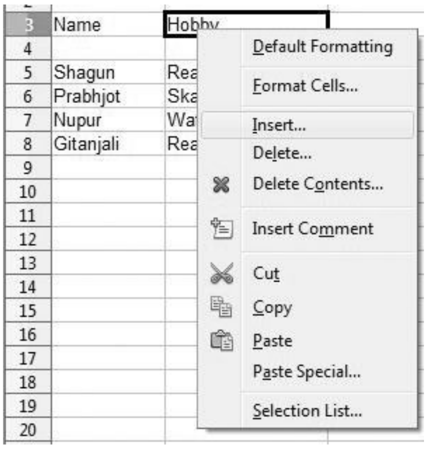


Fig. 9.15: Insert option

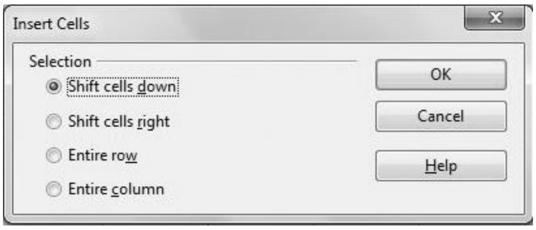


Fig. 9.16: Insert Cells dialog box

It has four options :

- *Shift Cells down*: The existing cells are shifted towards the bottom of the worksheet and a new cell is inserted.
- *Shift Cells Right:* The existing cells are shifted to the right of the worksheet and a blank cell is inserted.
- *Entire Row*: A new row is inserted above the selected range of rows.
- *Entire Column*: A new column is inserted to the left of the selected range of columns.

4. Select the desired option and click **OK**.

9.10.5 Deleting Cells/Rows/Columns

To delete cells, rows or columns from the worksheet, follow the steps given below:

1. Select the cell or range of cells where you want to delete a cell, row or column.

2. Right click and choose **Delete…** option from the shortcut menu (Fig. 9.15).
3. The **Delete Cells** dialog box is displayed (Fig. 9.17) with the following four options:

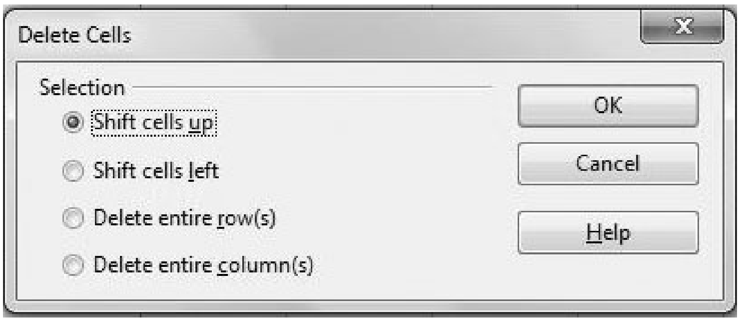


Fig. 9.17: Delete Cells dialog box

- *Shift Cells Up*: The selected cells are deleted and the cells below the deleted cells shift up.
- *Shift Cells Left*: The selected cells are deleted and the cells on the right of the deleted cells shift towards the left.
- *Delete Entire Row(s):*Deletes entire row(s).
- *Delete Entire Column(s):*Deletes entire column(s).

4. Select the appropriate option and click **OK**.

9.11 AUTOFILL FEATURE

AutoFill feature of OpenOffice Calc is used to fill sequential data in the cells to form a series automatically. The series to be formed may be numerical or alphabetical. OpenOffice Calc automatically fills the range of cells with the appropriate data. Let us use this feature to insert month names in the worksheet.

1. Type January in cell A3 (Fig. 9.18).
2. Position the pointer at the lower right corner of the cell.
3. The mouse pointer changes to a plus sign(+) and is known as the **fill handle.**
4. Hold down the left mouse button and drag the fill handle up to cell A14.
5. Release the mouse pointer. The days February to December will appear, automatically in the subsequent cells in the range. Similar mechanism works for names of days of week as well.

Notes

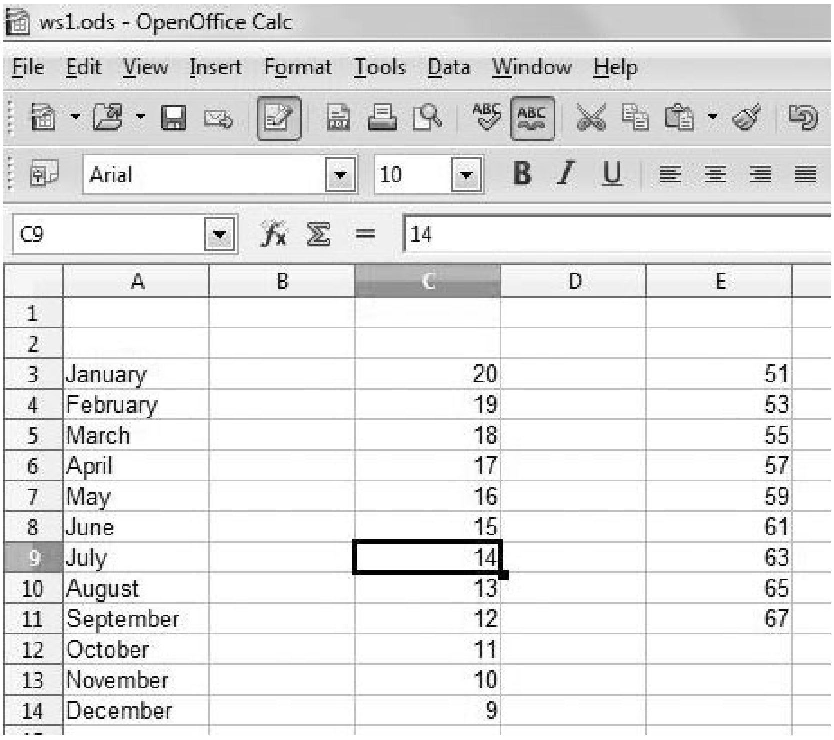


Fig. 9.18: Examples of AutoFill Feature

Let us consider some more examples to use the AutoFill feature (Fig. 9.18). If we enter 20 in cell C3 and 19 in cell C2, select both the cells and then click and drag the fill handle, we will see that numbers in decreasing order are displayed in the selected range. In another example, if we enter 51 in cell E3 and then 53 in cell E4, AutoFill feature will display all odd numbers in the selected range starting from 51. Hence, this feature uses the difference between the first two numbers to fill the range of cells automatically.

9.12 SORT LISTS

The AutoFill feature of OpenOffice Calc uses two lists that are already stored in the Calc application. These are names of months of the year and names of days of the week. That is why these are automatically filled in the selected range of cells. Such type of lists are called **Sort Lists**. We can create our own Sort Lists by following the steps given below:

1. Click **Tools → Options**. The **Options** dialog box is displayed with OpenOffice option already selected.

2. Click the plus sign **(+)** before **OpenOficeCalc** option.

3. From the list of options click **Sort Lists** option. The right side of the dialog box shows the sort lists already stored in Calc (Fig. 9.19).

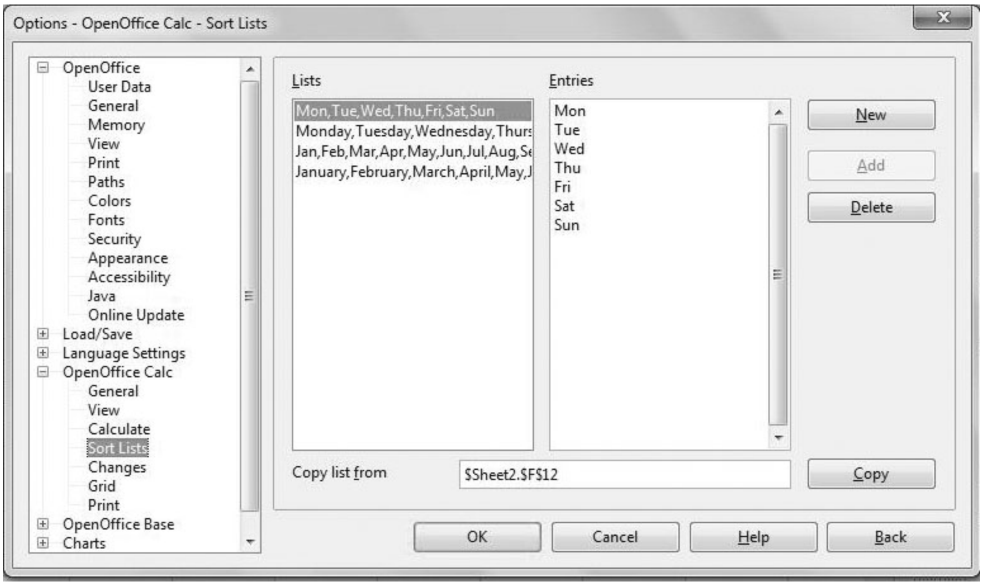


Fig. 9.19: Options dialog box

4. Click **New** button. The cursor appears in the **Entries box**.

5. Type each entry (in the desired order), pressing **Enter** key after each list item. In Fig. 9.20, we have typed the names of the subjects.

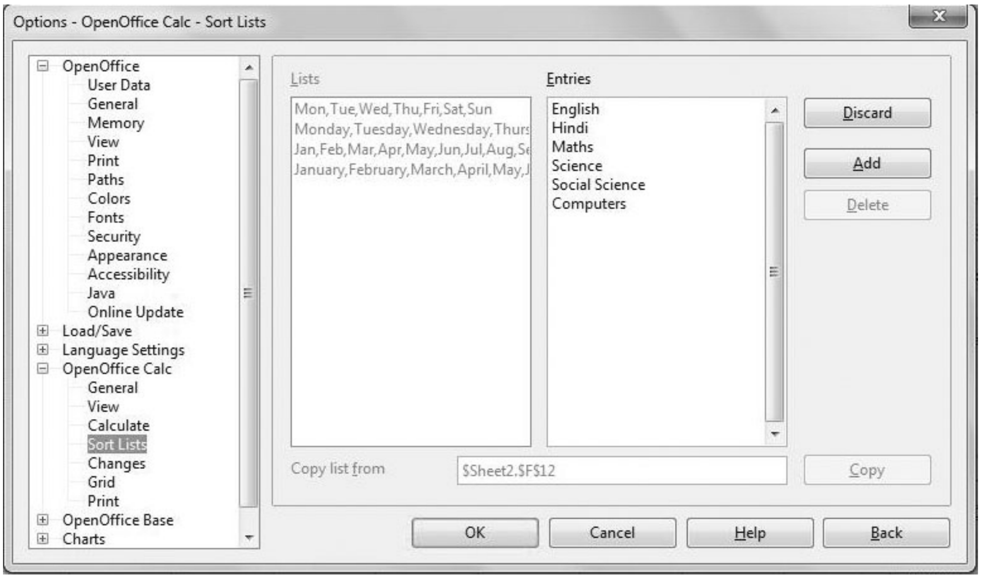


Fig. 9.20: Creating a Sort List

6. Click the **Add** button. In the **Lists box,** the new list appears in the same order as we entered in the **Entries box**.

7. If the elements of the list are typed in the worksheet and we want to create a sort list with them, we may select the entire list and then open the **Options** dialog box as per the method given above. The selected range will be

Notes

displayed in the **Copy List from** text box. Click **Copy** button to add to the main Sort Lists text box.

8. Click **OK** to close the Options dialog box.

   Now if we type English in any cell on the worksheet and drag the fill handle, we will see that the subjects entered while creating the lists automatically fill up the selected range.

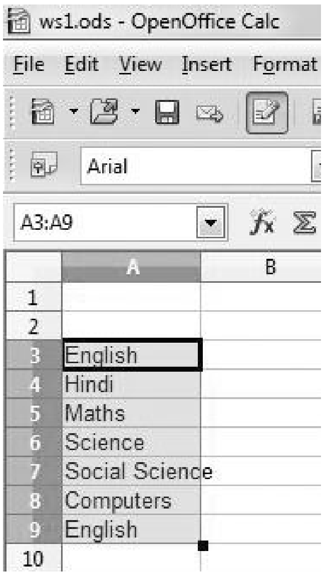


Fig. 9.21: AutoFill using the created Sort List

Also, if any of the sort lists have to be deleted, simply select the list and click **Delete** button in the **Options** dialog box.

INTEXT QUESTIONS 9.2

1. Fill in the blanks:
   (i) .... is the shortcut key to edit data in cells.
   (ii) Press .... key while selecting adjacent cells in a worksheet.
   (iii) Cancel Editing button is present on the .... toolbar.
   (iv) All formulas must start with an .... sign.
   (v) The data on which arithmetic calculations cannot be performed is called ....
2. How can you select the entire row in a worksheet?
3. What is the use of AutoFill feature?
4. Name the two ways of editing cell contents in OpenOffice Calc.

Notes

9.13 FORMATTING CELL CONTENTS IN CALC

Formatting is altering the style and appearance of data to enhance the appearance of the worksheet without affecting the data values. As we have done before that data can be either text or numeric, formatting can also be categorized into text formatting and number formatting. All the formatting commands are present on the formatting toolbar (Fig. 9.22).

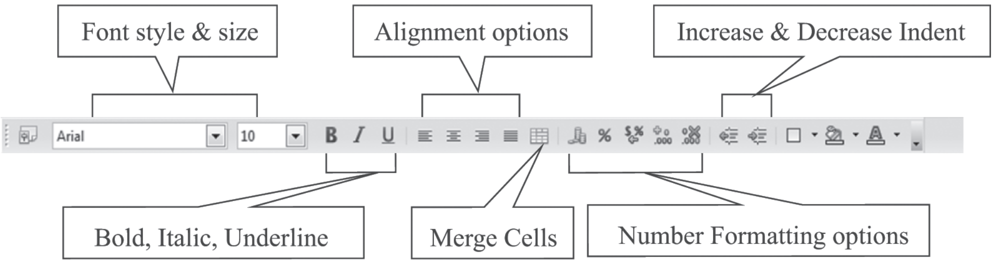


Fig. 9.22: Formatting Toolbar

9.13.1 Text Formatting

The desired font style, size and colour can be applied by selecting the text and clicking the appropriate icon on the formatting toolbar. We may even make the text bold, italic or underlined or even choose the background colour of cell(s) from the toolbar.

Alignment refers to the position of the data with respect to the boundary of the cell. By default, numbers and Date/Time data is always right aligned while textual data is left aligned. Vertically, all types of data appear at the bottom of the cell. To change the alignment, click on the desired alignment button on the formatting toolbar.

Orientation refers to rotating text according to the specified angle. This is often used for labelling narrow columns. The default orientation of the text is horizontal. To alter the orientation of the text, follow the steps given below:

1. Select the cell(s) for which the orientation has to be changed.
2. Select **Format → Cells**. The **Format Cells** dialog box is displayed (Fig. 9.23).
3. Click the **Alignment tab**.
4. In the **Text orientation** section, set the degrees by which the text has to be rotated. The preview shows the text accordingly.
5. Click OK button to view the rotated text on the worksheet.

Notes

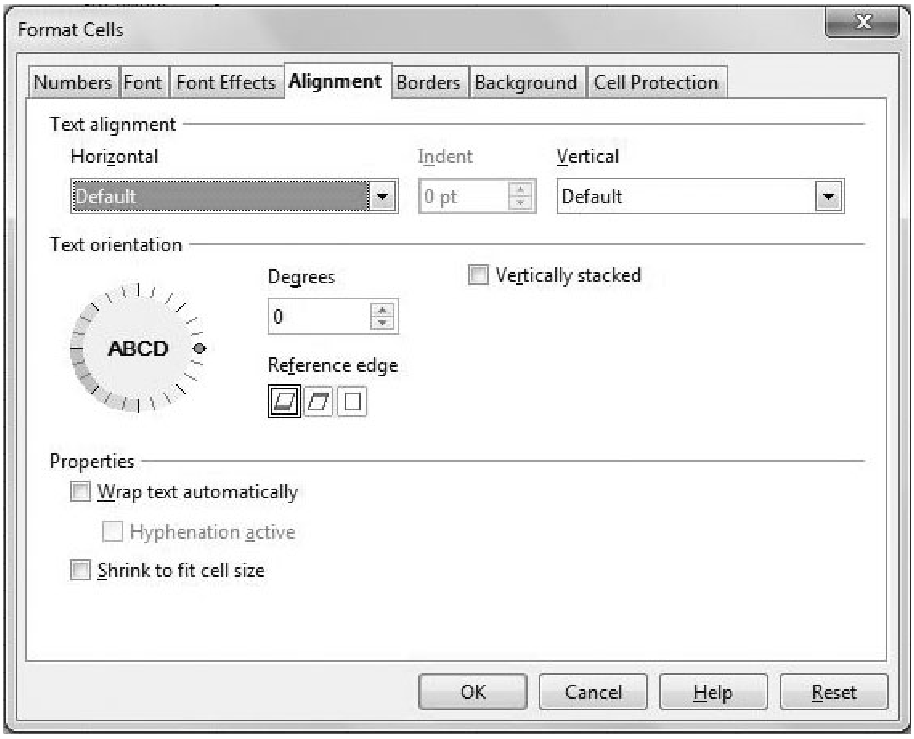


Fig. 9.23: Format Cells dialog box – Alignment tab

Fig. 9.24 shows the text 'Activities' at various degrees of orientation.

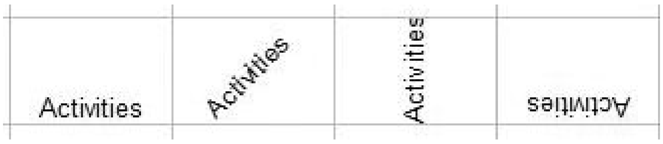


Fig. 9.24: Text orientation

9.13.2 Merging and Wrapping Text

These two features are helpful to display long text in a single cell. Wrapping text means to make the entire cell content visible in a single cell by displaying it in multiple lines of the same cell. On the other hand, merging is the feature that makes the long text to merge with the adjacent cells and form one large cell.

Consider the long text 'Invoice cum Receipt number for Electronic Items' in cell A1 as shown in Fig. 9.25.

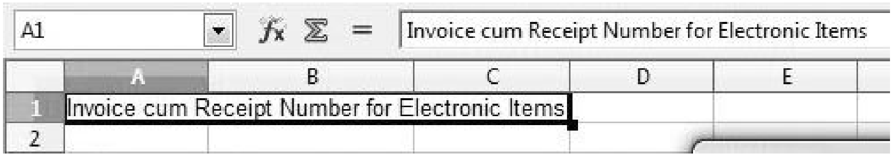
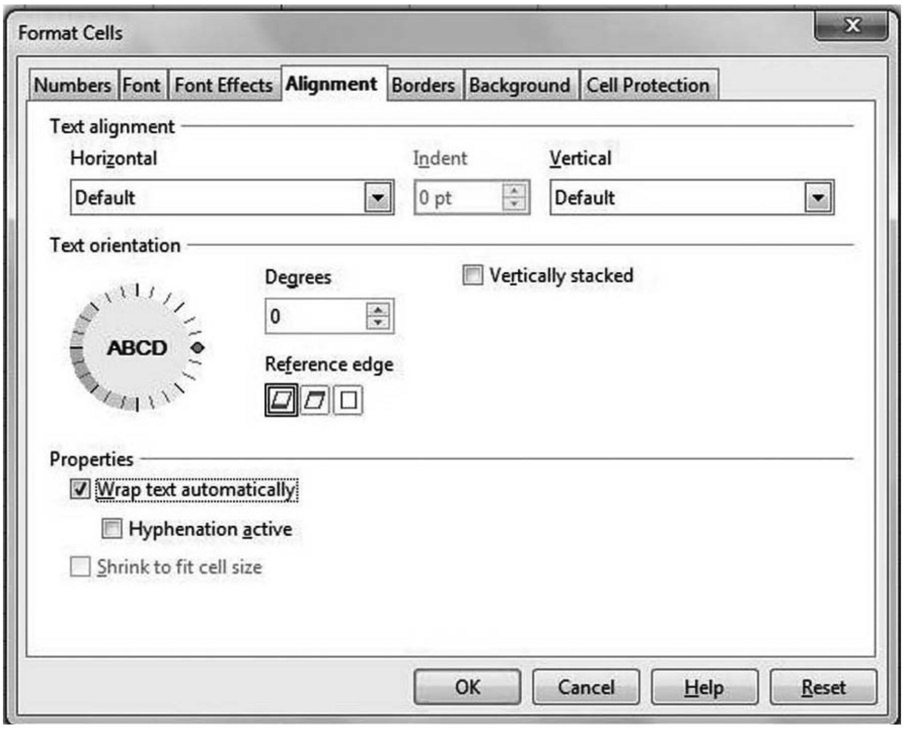


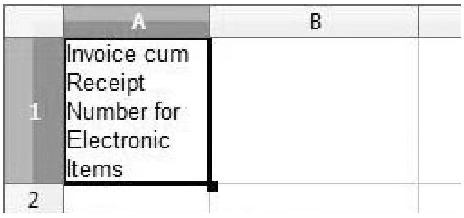
Fig. 9.25: Long text

Notes

To wrap this text, select the cell A1 and click **Format → Cells → Alignment** option. In the **Format Cells** dialog box, select **Wrap text automatically** checkbox in the **Properties** section (Fig. 9.26 (a)). The text will be wrapped in multiple lines as shown in the Fig. 9.26 (b).



(a)



(b)

Fig. 9.26: Wrapping text

To merge cells, select the range of cells to be merged and click **Merge Cells** button on the formatting toolbar. In the example given in Fig. 9.25, select cells A1: C1 and then click **Merge Cells** button. The text will be merged into a single cell as shown in the Fig. 9.27.

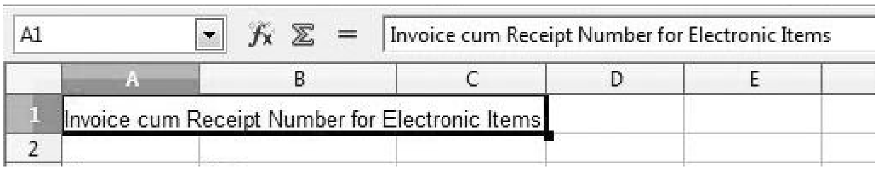


Fig. 9.27: Merging Cells

9.13.3 Number and Date Formatting

Numerical data is predominantly found in almost all spreadsheet. Calc allows us to format numbers in a variety of ways like displaying currency, placing commas to separate long numbers, adding percentage (%) sign, specifying number of decimal places and so on. Similarly date and time can also be displayed in variety of formats.

You can either use the formatting toolbar or perform the following steps to apply number and date formatting to the cell contents:

1. Select the cell(s) whose content has to be formatted.
2. Select **Format → Cells**. The **Format Cells** dialog box appears (Fig. 9.28).
3. Select the **Numbers** tab, if not selected.

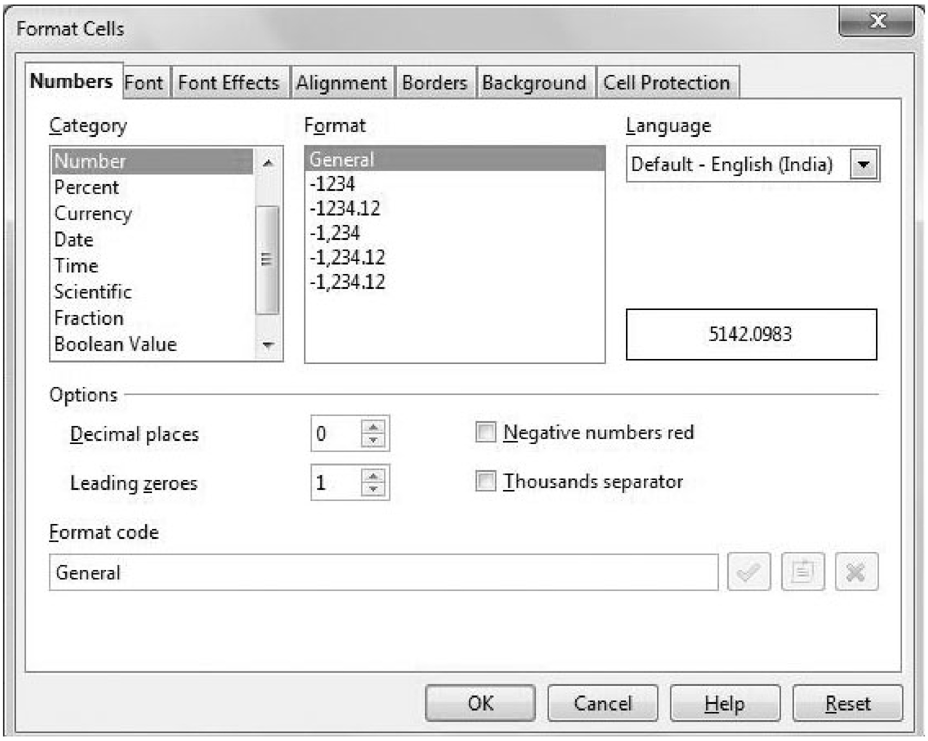


Fig. 9.28: Format Cells dialog box – Numbers Tab

4. Choose the desired **Category** (Number, Percent, Date, Time etc.) and then the desired **Format** from the respective list boxes. The preview of the selected format is displayed in the **Preview** text box.
5. Click **OK** button to apply the selected style.

9.14 USING FUNCTIONS

Functions are predefined formulas in any spreadsheet application. Various functions are provided by Calc to perform various operations on numerical, date,

time and text data. These functions may perform mathematical operations like addition, subtraction, multiplication, average etc., or may display current date and time or may join two texts and so on. The data values given to these functions for performing the specified operation are known as **arguments**. These arguments may be given in the form of numbers or in the form of cell addresses.

All functions must begin with an equal (=) sign. The basic structure of a function is shown below:

= Name of function(argument list)

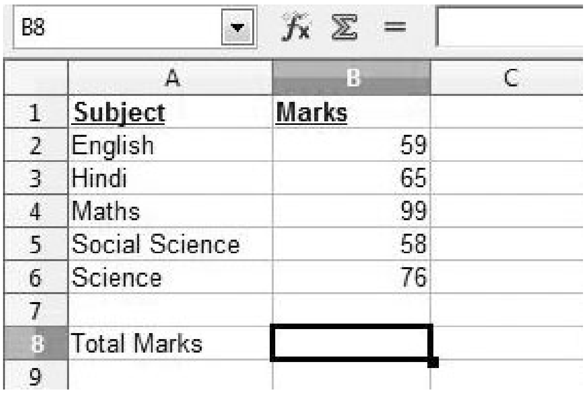
Here argument list may contain any number of arguments. Let us now learn to use some commonly used functions in OpenOffice Calc.

Sum ()

The Sum () adds the numbers given in the argument list. The result is displayed in the active cell containing the function. The syntax for Sum() is

=Sum (num1; num2; num3;……)

For example, to display the sum of 20, 30 and 40, we have to type = Sum (20;30;40) in the active cell. The range of cells can also be mentioned in the formula. For example, to display the sum of numbers stored in cells C3 to C10 will be written as =sum(C3:C10). Consider the worksheet as shown in Fig. 9.29 containing marks in five subjects.


B8

	A	B	C
1	Subject	Marks	
2	English	59	
3	Hindi	65	
4	Maths	99	
5	Social Science	58	
6	Science	76	
7			
8	Total Marks		
9			

Fig. 9.29: Finding total marks

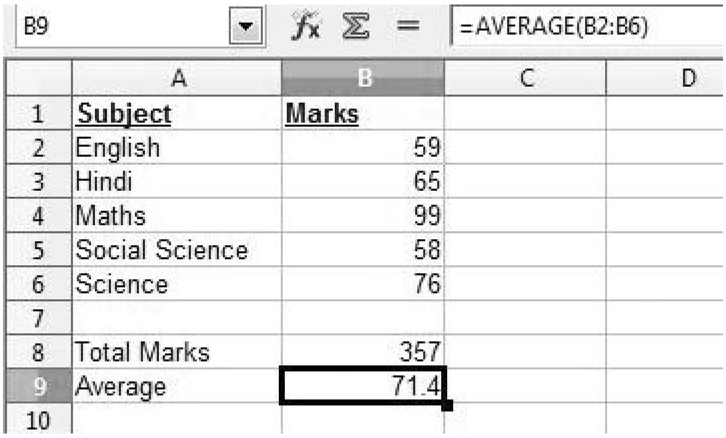
To calculate and display the total marks in cell B8, follow the steps given below:

1. Click the cell where sum has to be displayed. In our example, cell B8 is the active cell.
2. Type = sum (B2:B6) and press **Enter** key. The sum will be displayed in cell B8. Now, if we change any of the values in cells B2:B6, the sum will automatically change.

Notes

Average ()

This function is used to calculate average of all the arguments being passed. Click on cell where average has to be displayed (B9, in Fig. 9.30) and type = Average (B2:B6). Press **Enter** key to display the average marks.



B9 =AVERAGE(B2:B6)

	A	B	C	D
1	Subject	Marks		
2	English	59		
3	Hindi	65		
4	Maths	99		
5	Social Science	58		
6	Science	76		
7				
8	Total Marks	357		
9	Average	71.4		
10				

Fig. 9.30: Finding average marks

Len ()

This text function displays the total number of characters in a cell. In Fig. 9.30, =Len(A2) will display the total number of characters in cell A2 (i.e., 7). Similarly =Len(A5) will display 14.

Today ()

This function displays the system date and does not take any argument. Click the cell where the current date has to be displayed. Type = today() and press **Enter** key. The current system date will be displayed.

9.14.1 Function Wizard

OpenOffice Calc provides numerous functions to perform various operations on data entered in the cells. All these functions can be accessed through the Function Wizard. To use Function Wizard, follow the steps given below:

1. Click the **Function Wizard** button (fx) near the Name box. The **Function wizard** starts(Fig. 9.31).
2. Select the category of functions from the **Category** list box. Let us calculate the minimum marks of all the subjects in the worksheet displayed in Fig. 9.30. So we choose the category as *Statistical*.
3. The corresponding list of functions is displayed in the **Functions** list box. Select **MIN** function. The name of the function appears in the **Formula** textbox (Fig 9.31).

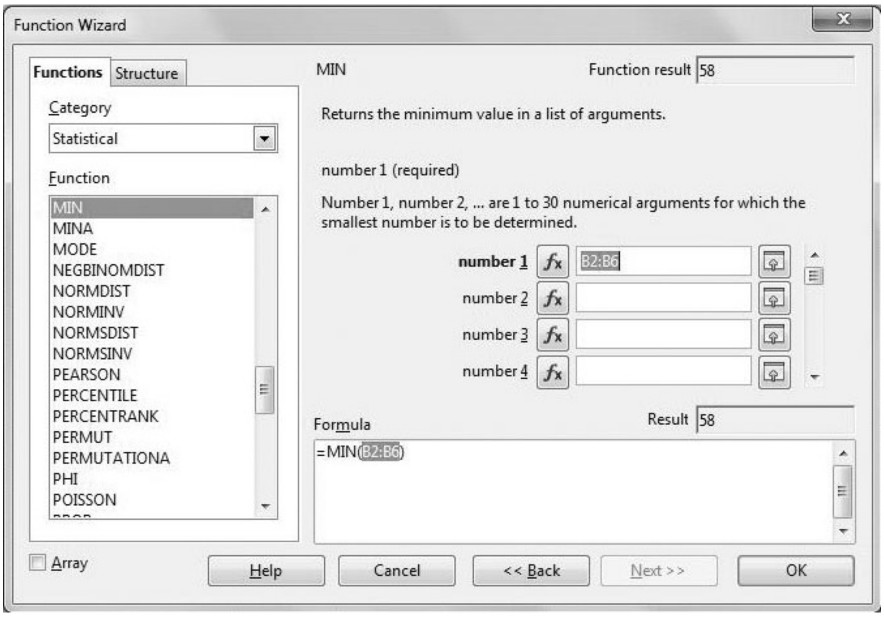


Fig. 9.31: Function Wizard

4. To specify the argument list, click **Select** button in front of **number 1** textbox.

5. The Calc worksheet appears (Fig. 9.32). Click and drag to select the range of cells from which the minimum value has to be found. In our example, this range is B2: B6 (bordered with red colour in the Fig. 9.32).

Click Function button ( ) on the extreme right of the Calc window to display the docking toolbar containing all the functions and also the Function Wizard button.

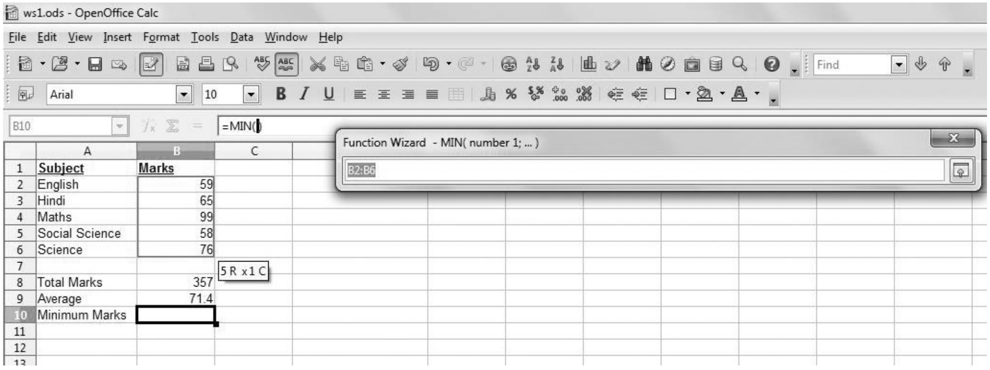


Fig. 9.32: Calc Worksheet to select the argument list

6. The selected range appears in the **Argument** text box. Click **Select** button again to go back to the Function Wizard. The function =MIN (B2:B6) is seen in the **Function** text box also.

7. Click OK to close the wizard and display minimum value in the active cell as shown in Fig. 9.33.

Notes

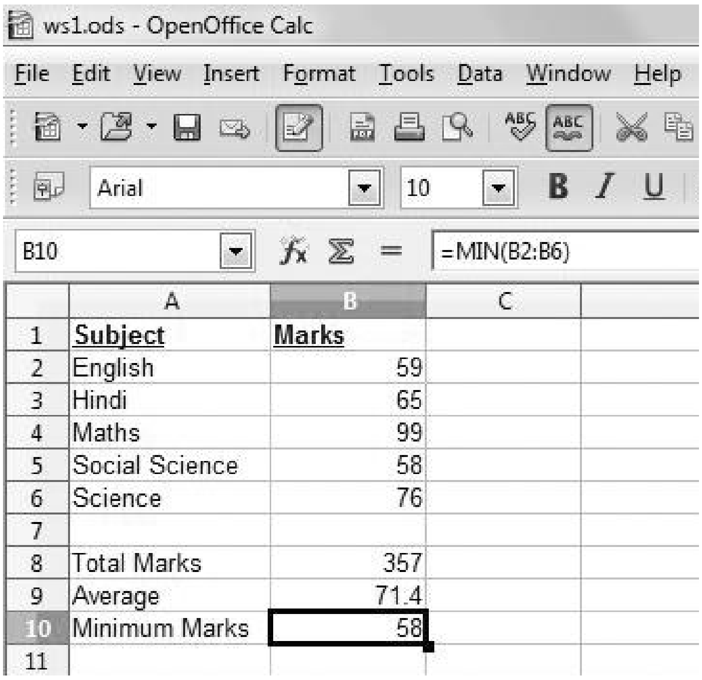


Fig. 9.33: Minimum Value using MIN ()

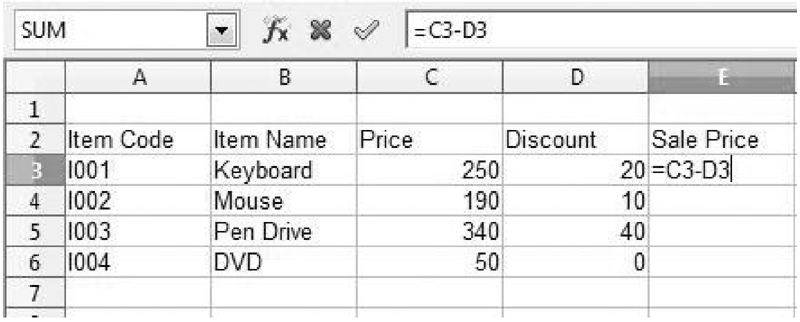
9.15 CELL REFERENCING

Cell reference is the address of the cell. By using cell referencing we can refer to a cell or a range of cells in a formula itself. In this way, the formulas will show updated results automatically if the value in a particular cell, being used in the formula changes or if the source cells are copied or moved. Based on how a cell reference in the formula is to be copied and used, cell referencing is of three types – relative referencing, absolute referencing and mixed referencing.

9.15.1 Relative Referencing

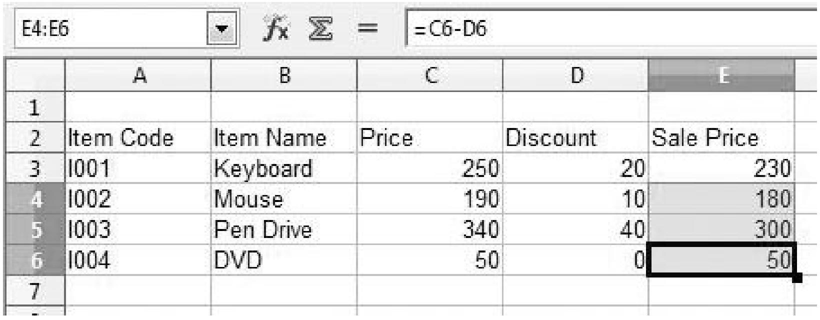
In this type of cell referencing, when the formula is copied from one cell to another in a worksheet, the cell reference or address of the cells being used in the formula automatically changes according to the relative position of the copied formula. Hence, this type of referencing is based on the relative position of the cell in which the formula is being pasted with respect to the cell address appearing in the formula. Consider the example shown in Fig. 9.34. To calculate the sale price of the item keyboard, the formula to subtract discount from price (=C3-D3) is entered in cell E3. Thereafter, the formula is copied to cells E4. The formula bar will now show the formula as C4-D4, thereby giving the correct sale price of item in row 4 i.e., mouse. Similarly, relative referencing is applied when the formula is copied to cells E5 and E6. This is because the relative position of the cell containing data and the cell containing the formula is same.

Notes



	A	B	C	D	E
1					
2	Item Code	Item Name	Price	Discount	Sale Price
3	I001	Keyboard	250	20	=C3-D3
4	I002	Mouse	190	10	
5	I003	Pen Drive	340	40	
6	I004	DVD	50	0	
7					

(a)



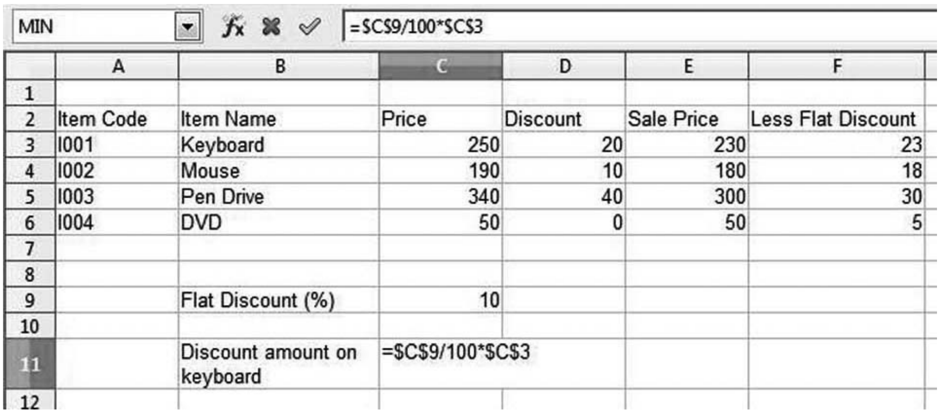
	A	B	C	D	E
1					
2	Item Code	Item Name	Price	Discount	Sale Price
3	I001	Keyboard	250	20	230
4	I002	Mouse	190	10	180
5	I003	Pen Drive	340	40	300
6	I004	DVD	50	0	50
7					

(b)

Fig. 9.34: Relative referencing

9.15.2 Absolute Referencing

In this type of referencing, the address or the reference of the cell in the formula is not changed when the formula is copied from one cell to another. To make absolute reference of a formula, add a **dollar ($)** sign before the column and the row number. For example, $B$1. Now, when the formula is copied, the address of this cell (i.e., B1) will not change. In the example given in Fig. 9.35, the flat discount percentage is given in cell C9. So when the discount on keyboard is calculated (discount/100 * price of keyboard) , the formula used is = $C$9/100 * $C$3. This is **absolute referencing**. Now when the formula is copied to any other location, the cell address will not change. It will always be C9 for discount percentage and C3 for price.



	A	B	C	D	E	F
1						
2	Item Code	Item Name	Price	Discount	Sale Price	Less Flat Discount
3	I001	Keyboard	250	20	230	23
4	I002	Mouse	190	10	180	18
5	I003	Pen Drive	340	40	300	30
6	I004	DVD	50	0	50	5
7						
8						
9		Flat Discount (%)	10			
10						
11		Discount amount on keyboard	=$C$9/100*$C$3			
12						

(a)

Notes

C11 | =$C$9/100 * $C$3

	A	B	C	D	E	F
1						
2	Item Code	Item Name	Price	Discount	Sale Price	Less Flat Discount
3	I001	Keyboard	250	20	230	23
4	I002	Mouse	190	10	180	18
5	I003	Pen Drive	340	40	300	30
6	I004	DVD	50	0	50	5
7						
8						
9		Flat Discount (%)	10			
10						
11		Discount amount on keyboard	25			
12						

(b)

Fig. 9.35: Absolute Referencing

9.15.3 Mixed Referencing

This type of cell referencing is the combination of absolute and relative referencing. Hence in this type of referencing either the row number is fixed or the column name is fixed. The cell references like $B1 or B$1 are examples of mixed referencing. In Fig. 9.36 below, the formula =E3 * $F3 entered in cell G3 is an example of mixed referencing.

MIN | =E3-$F3

	A	B	C	D	E	F	G
1							
2	Item Code	Item Name	Price	Discount	Sale Price	Qty	Amount
3	I001	Keyboard	250	20	230	5	=E3-$F3
4	I002	Mouse	190	10	180	4	
5	I003	Pen Drive	340	40	300	2	
6	I004	DVD	50	0	50	6	
7							

Fig. 9.36: Mixed Referencing

9.16 SORTING OF DATA

Sorting means arranging data in ascending or descending order. The data to be sorted may be numeric or textual or both. Consider the worksheet given in Fig. 9.37 showing the sales figures of five sales persons. Follow the steps given below to sort data in descending order of sales amount.

A4:B8 | 11500

	A	B	C
1			
2	Salesperson's Name	Sales Amount	
3			
4	Rocky	12000	
5	Smita	45000	
6	Rahul	8000	
7	Jatin	14000	
8	Shalini	11500	
9			

Fig. 9.37: Sorting of data

1. Select the data range to be sorted (A4: B8).

2. Click **Data** → **Sort**. The **Sort** dialog box appears (Fig. 9.38).

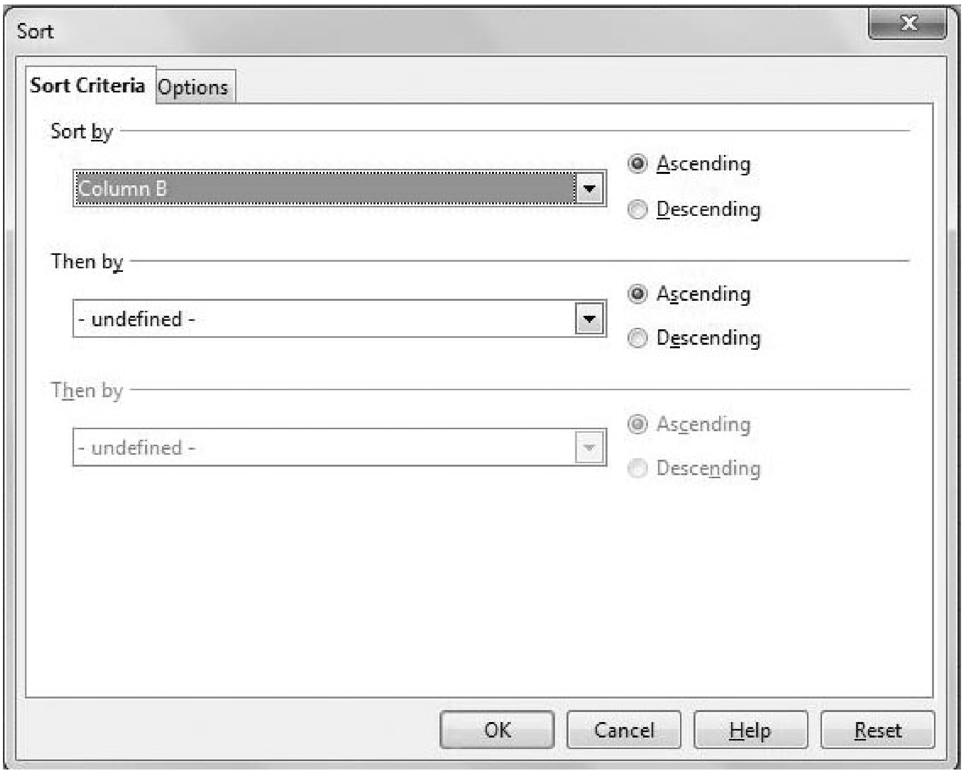


Fig. 9.38: Sort dialog box

Notes

3. The **Sort Criteria** tab is already selected. Specify the column according to which the data has to be sorted. In our example, it is column B.
4. Select the order in which the data has to be sorted – ascending or descending. Since we have to sort in descending order of sales amount, so we select **Descending** radio button.
5. Calc gives you option to sort data according to multiple columns also. Select the column in **Then by** list box in that case.
6. Click **OK** to see the data sorted in descending order of sales amount (Fig. 9.39).

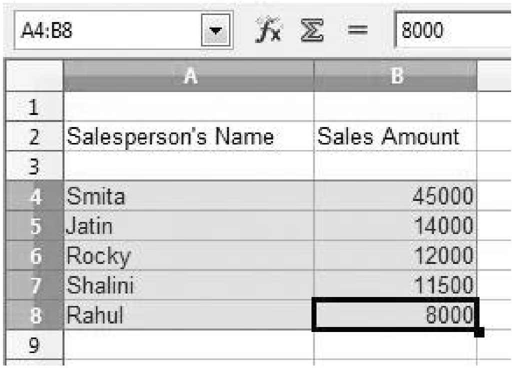
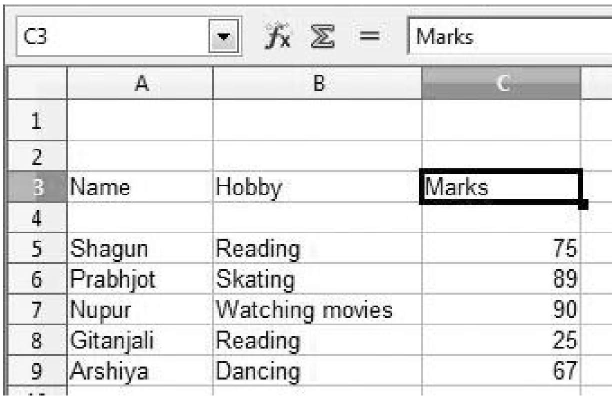


Fig. 9.39: Data sorted in descending order of Sales Amount

9.17 FILTERING DATA

Filter feature of OpenOffice Calc blocks or hides the data based on specified criteria for a column. Unlike sorting, the data is not rearranged in case of filtering. Instead, the filtered subset of data is extracted and the rest is temporarily hidden from the user. This filtered data can then be edited, analysed, formatted or even printed. Consider the following worksheet (Fig. 9.40) and follow the steps given below to see filtered data.



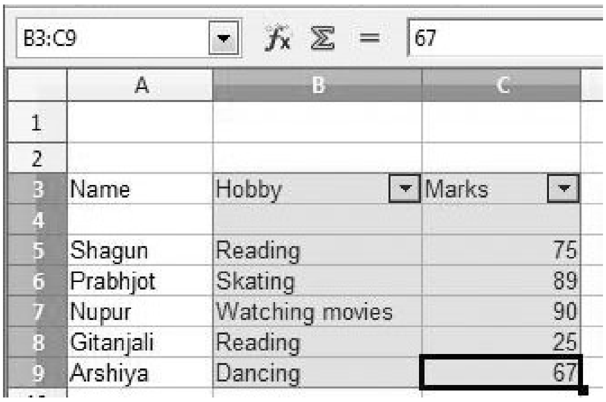
C3 | Marks

	A	B	C
1			
2			
3	Name	Hobby	Marks
4			
5	Shagun	Reading	75
6	Prabhjot	Skating	89
7	Nupur	Watching movies	90
8	Gitanjali	Reading	25
9	Arshiya	Dancing	67

Fig. 9.40: Data before applying filter

1. Select the column(s) on the basis of which filtering has to be done. Since we want to filter records based on Column B i.e., Hobby and Column C i.e., Marks, so we select the range B3:C9.

2. Select **Data → Filter → AutoFilter**. You will see that a filter icon ( ) appears on column headers i.e., Hobby and Marks (Fig. 9.41) indicating that the filter is applied on these two columns.



B3:C9 | 67

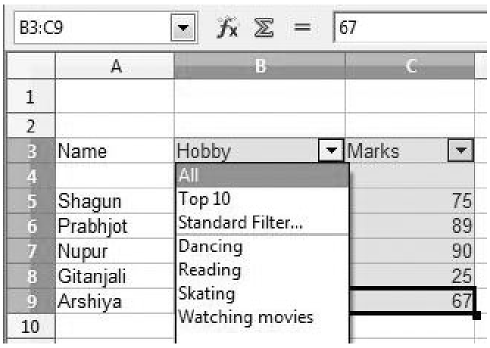
	A	B	C
1			
2			
3	Name	Hobby	Marks
4			
5	Shagun	Reading	75
6	Prabhjot	Skating	89
7	Nupur	Watching movies	90
8	Gitanjali	Reading	25
9	Arshiya	Dancing	67

Fig. 9.41: Filtering Data

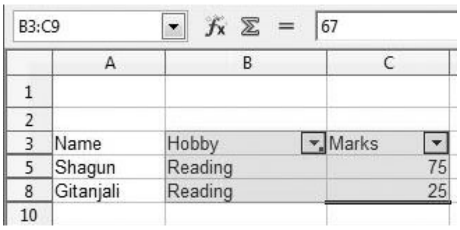
3. If we want to view the data of the students who have hobby as reading, then click the filter arrow in the Hobby column header and select Reading

Notes

from the submenu (Fig. 9.42 (a)). The filtered data is displayed on the worksheet (Fig. 9.42(b)).



(a)



(b)

Fig. 9.42: Displaying Filtered data

4. Similarly if we want to filter data of those students whose marks are less than 70, click the filter arrow in Marks column header and select **Standard Filter** option. The **Standard Filter** dialog box will be displayed (Fig. 9.43). The field name, Marks is already entered. From the **Condition** list box, select <= and specify the value as 70 in the value combo box.

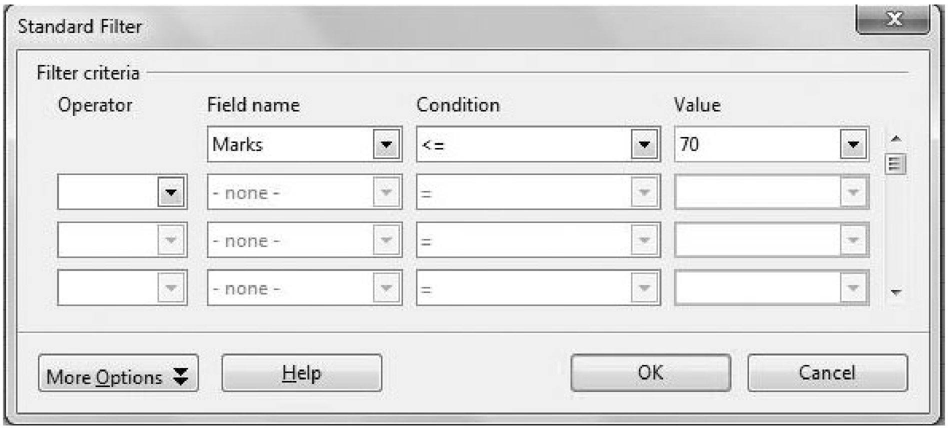


Fig. 9.43: Standard Filter dialog box

5. Click **OK** button. The filtered data with only those records whose marks are less than or equal to 70 is displayed (Fig. 9.44).

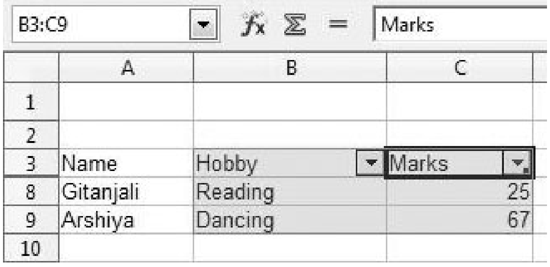


Fig. 9.44: Filtered data

Notes

9.18 MAKING CHARTS IN CALC

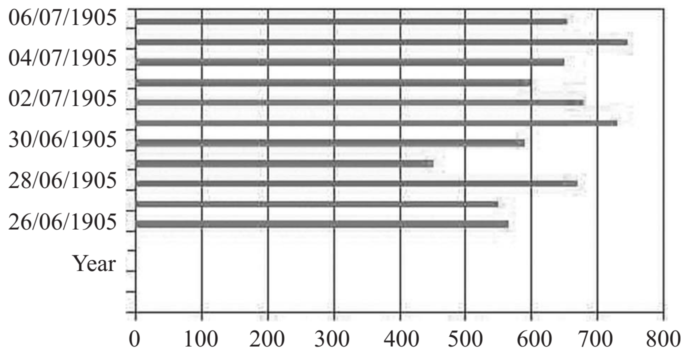
A chart is a form of pictorial representation of data. It is easier to explain a concept or to analyse and compare data using charts. The relationships between various sets of data can also be easily understood using charts. OpenOffice Calc provides various types of charts. The various types of charts provided by OpenOffice Calc.

1. Bar Chart

Feature: Displays data in the form long bars of different height, vertically or horizontally.

Application: Demonstrate comparison among individual items.

Example:

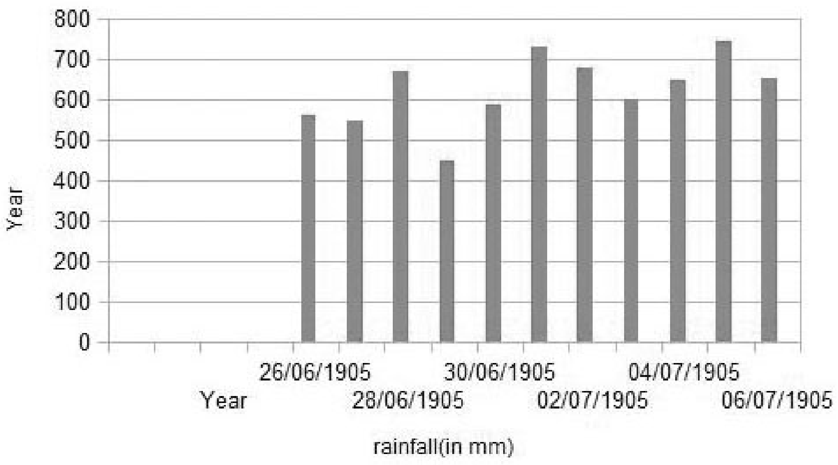


2. Column Chart

Feature: Data is represented in the form of vertical bars.

Application: Used to emphasize comparison of data items within specified period.

Example:

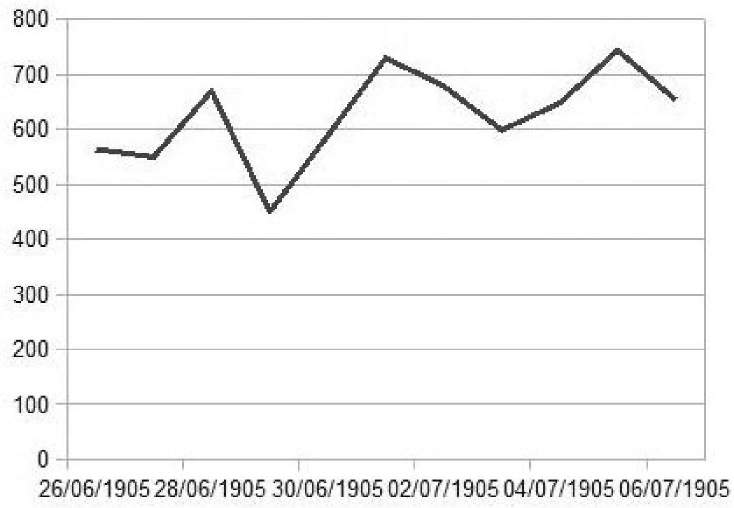


3. **Line Chart**

Feature : Series of data points are connected together with a line.

Application: Used to display data trends at regular intervals.

Example:

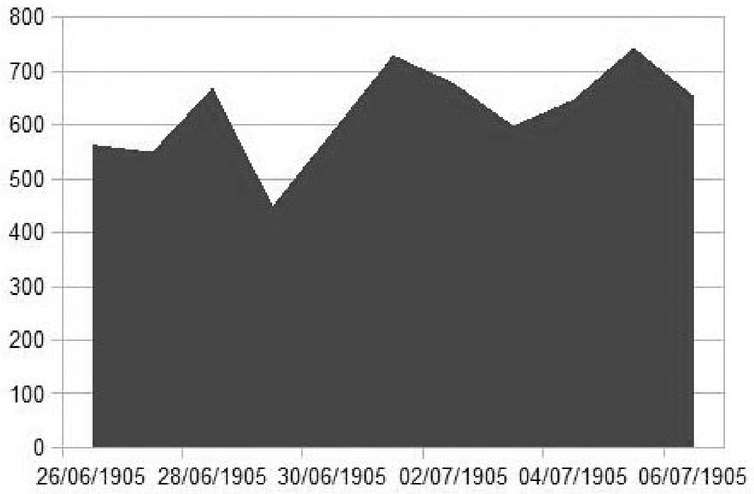


4. **Area Chart**

Feature: It is based on a line chart but the area between the axes and the lines is filled with different colours

Application: Used to highlight change over time or to display quantitative data graphically.

Example:



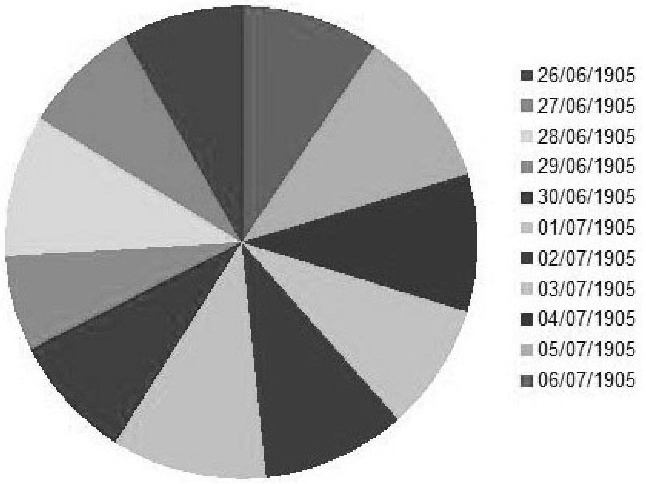
Notes

5. **Pie Chart**

Feature: Data is displayed in the form of circles divided into sectors whose size is proportional to the value it represents.

Application: Used to demonstrate the proportional size of the item with respect to sum of all items.

Example:

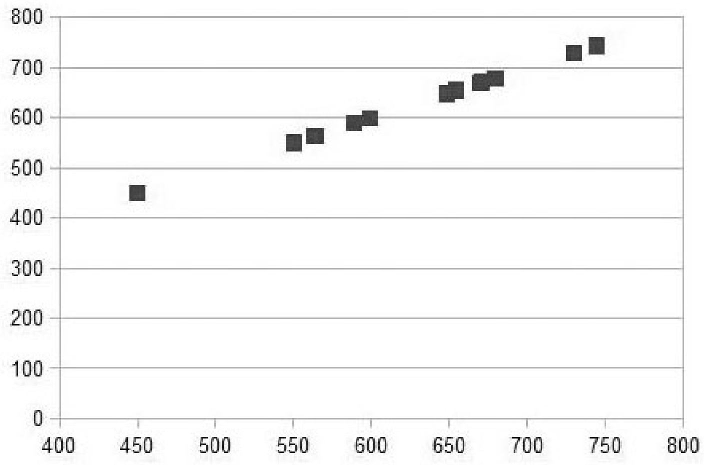


6. **XY(Scatter) Chart**

Feature: It is used to depict the relationship of numerical values using variety of data series. The location of points represents the value of the chart and the set of points depicts the data series.

Application: Used to analyse scientific data.

Example:

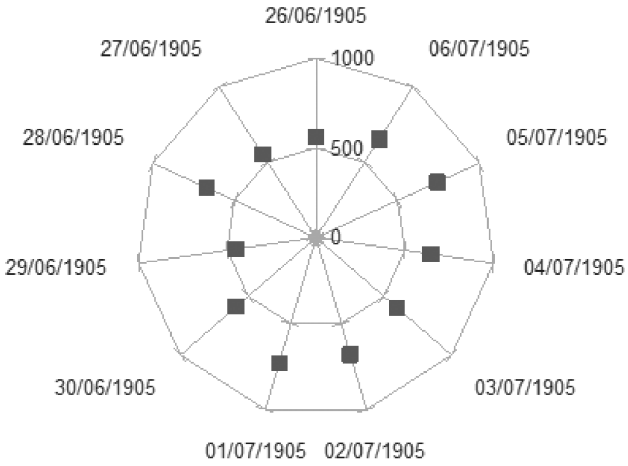


7. Net Chart

Feature: The data is displayed as points that are connected by some lines in a grid that looks like a spider's net. It plots the data of each row in a separate radial.

Application: Used to analyze records of multiple series.

Example:

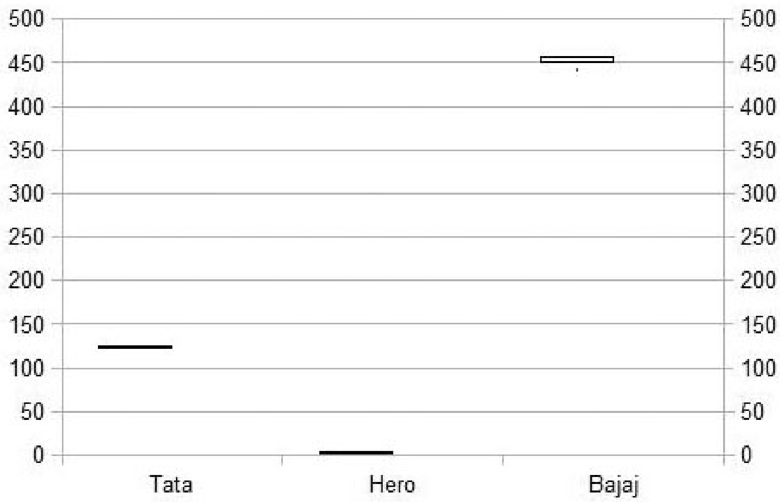


8. Stock Chart

Feature: It uses lines with markers (with height corresponding to the value being depicted) to show the data series.

Application: Used to analyze the stock market movement.

Example:



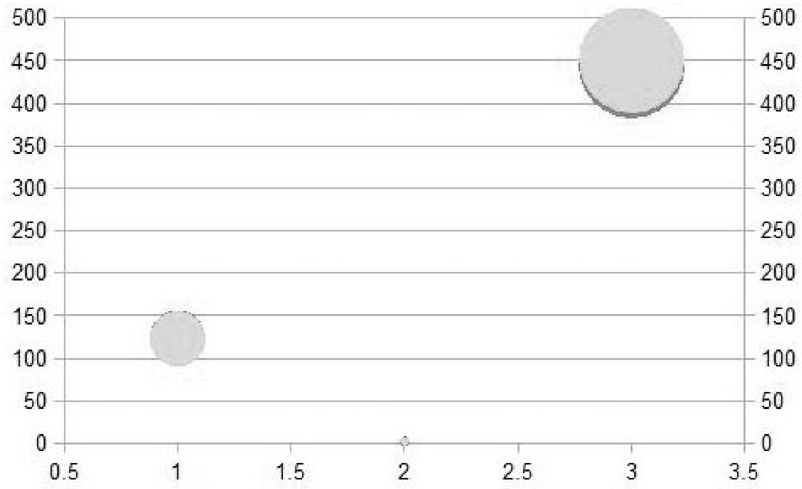
Notes

9. Bubble Chart

Feature: A variation of scatter chart in which data points are represented by bubbles. It can show relations of three variables in two dimensions.

Application: It is used to present financial data.

Example:

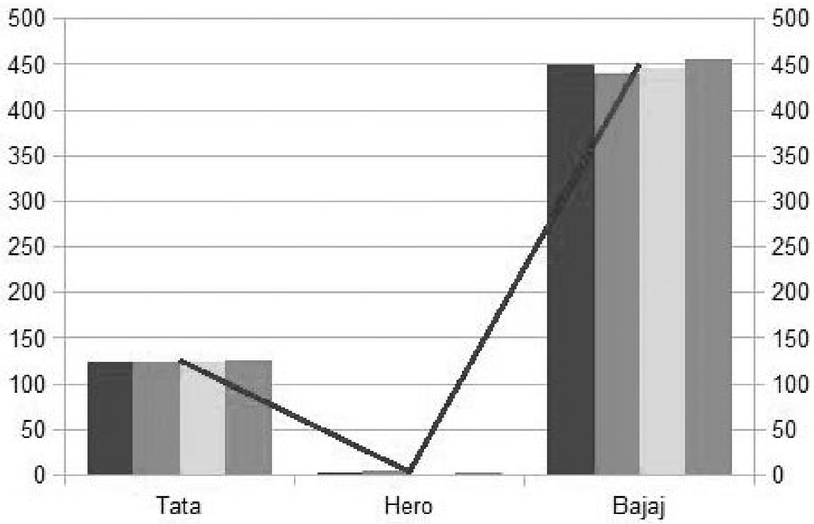


10. Column and Line Chart

Feature: A combination of line and column chart.

Application: Used to display data trends and at the same time compare them.

Example:



9.18.1 Components of a chart

The various components of a chart are shown in the Fig. 9.45 below. When we move the mouse pointer over a chart object, a screen tip giving the component's name is displayed.

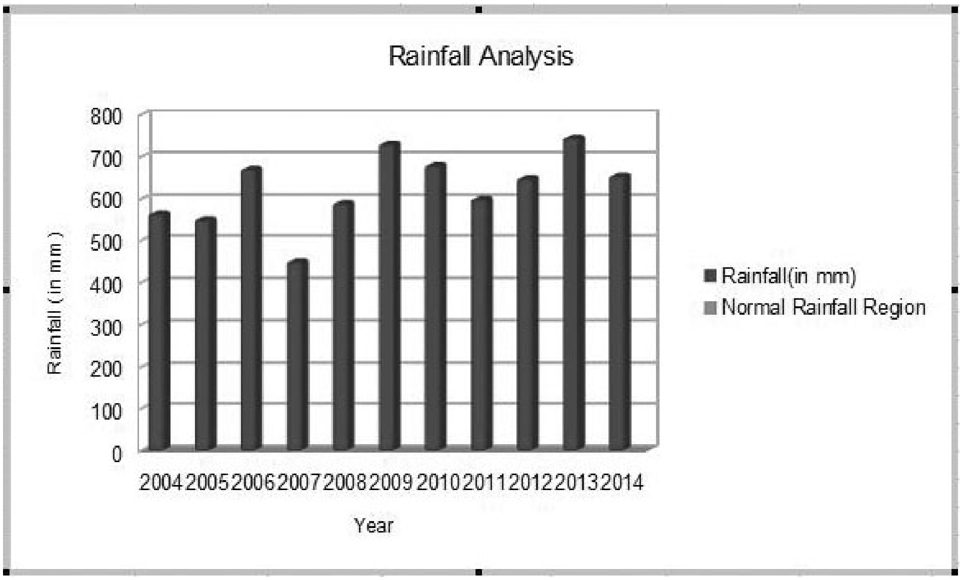


Fig. 9.45: Components of chart

Chart Area: It includes the total area in which all the components of the chart are placed.

Plot Area: It is the area, bounded by two axes for a 2-D chart and three axes for a 3-D chart. It contains the actual chart and also includes the plotted data, data series and the two axes.

Chart Title: It is the topic of the chart, usually given at the top. In Fig. 9.45, 'Rainfall Analysis' is the title of the chart. The title helps us to know what data can be inferred through the chart.

Axis titles: A 2-D chart has two axes (x & y) while a 3-D chart has three axes (x, y and z). Each axis is given a title, called **axis title**, which depicts what data series the respective axis is representing. In the Fig. 9.45 above Year and Rainfall(in mm) are X-axis and Y-axis titles respectively.

X-axis or Category Axis: It is the horizontal axis of the chart.

Y-axis or Value axis: It is the vertical axis used to plot the value of each data point.

Data Series: It is the set of data that we want to display in the chart.

Notes

Legend: It identifies the data series being represented in the chart. A unique colour, pattern or symbol is assigned to each data series so that they can be easily distinguished.

Gridlines: These are the horizontal and vertical lines that run across the plot area. It helps us to know the exact data point to be plotted.

9.18.2 Steps to create a chart

Follow the steps given below to create a chart:

1. Select the table or range of values for which the chart has to be created.
2. Select **Insert → Chart**. The **Chart Wizard** starts.
3. On the left side of the wizard are the steps to be followed to create a chart and on the right are corresponding actions of each step. For the first step, choose the **Chart type** and its **sub type** (Fig. 9.46). Click **Next** button.

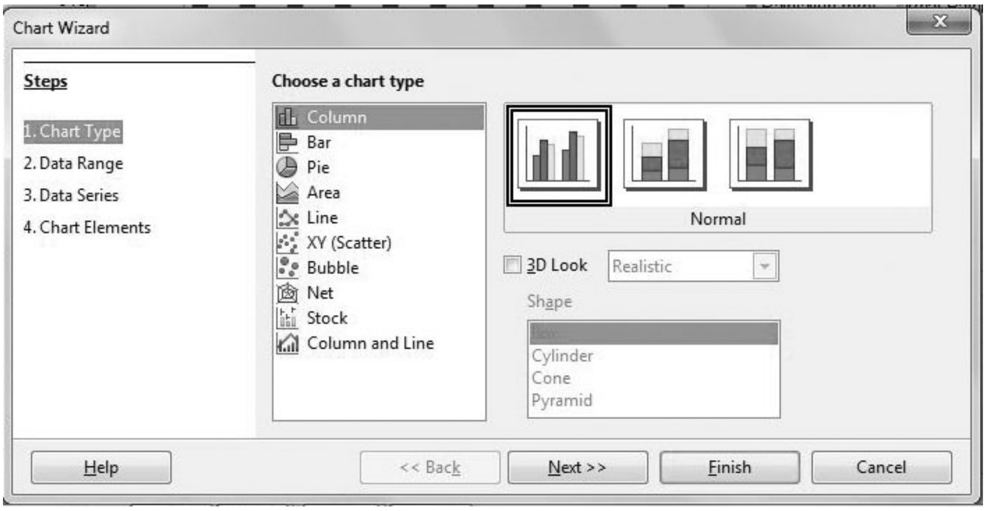


Fig. 9.46: Step 1 of Chart Wizard

4. Choose the data range for which the chart has to be created and then click **Next** button.
5. For step-3, specify the data series and data ranges.
6. In the last step, specify various chart elements like Chart title, Axis title etc. and then click on **Finish** button. The chart will be inserted in your worksheet (Fig. 9.47).

Notes

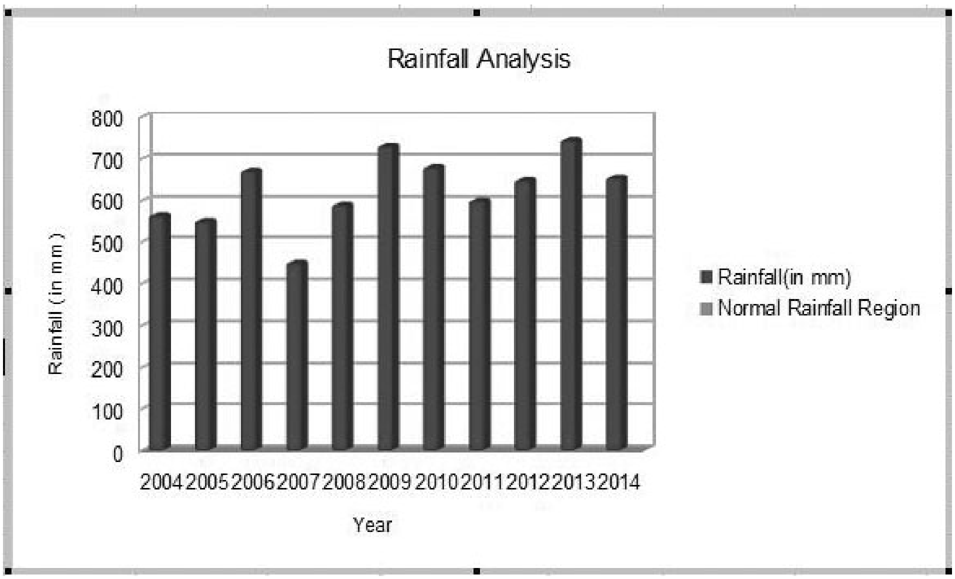


Fig. 9.47: Chart inserted on the worksheet

9.19 PRINTING A WORKSHEET

Follow the steps given below to print the worksheet or a chart.

1. Select **File → Print**. The **Print** dialog box appears (Fig. 9.48).

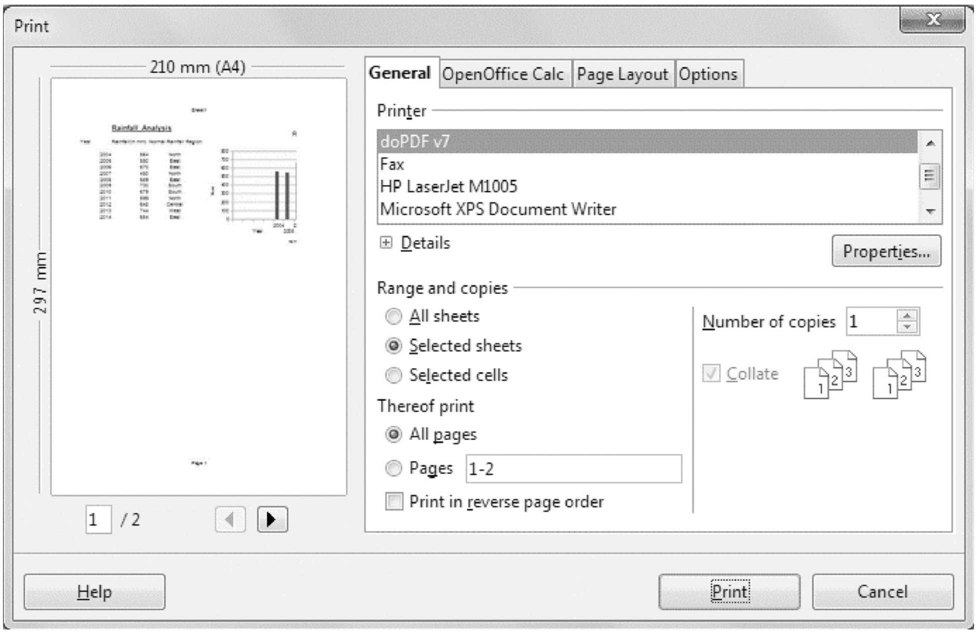


Fig. 9.48: Print dialog box

2. The left side of the dialog box shows the preview of the active worksheet. On the right, the **General tab** will be selected by default. Specify the Printer

Notes

name, range of worksheets to be printed and number of copies to be printed. If we want to print only the chart, then choose the *Selected sheets* option. Also make sure that the chart is selected on the worksheet.

3. Click **Print** button to print the worksheet.

INTEXT QUESTIONS 9.3

1. Fill in the blanks.

   (i) The function that displays current system date is ....

   (ii) The Cells option is in .... menu.

   (iii) $K$9 is an example of .... referencing.

   (iv) The type of chart in which data is represented as parts of a circle is .... chart.

   (v) The X-Axis in a chart is also known as .... axis.

   (vi) Various functions provided by OpenOffice Calc can be accessed using ....

2. Differentiate between filtering and sorting of data.

3. What is relative referencing? Give one example.

4. How can you merge cells on a worksheet?

WHAT YOU HAVE LEARNT

- Each page of a spreadsheet is known as a worksheet.
- Collection of worksheets constitutes a workbook.
- Autofill feature is used to fill sequential data in the cells to form a series automatically.
- Formatting is altering the style and appearance of data to enhance the appearance of the worksheet without affecting the data values.
- Funtions are predefined formulas in any spreadsheet application.
- Cell reference is the address of the cell.
- A chart is a form of pictorial representation of data.
- Components of a chart are chart area, plot area, chart title, axis titles, data series, legend, gridlines x axis, y axis.

TERMINAL EXERCISE

1. What is a spreadsheet? Name any two spreadsheet applications.
2. Explain the two ways to change the cell contents in OpenOffice Calc.
3. Why and how do we use the Function Wizard in OpenOffice Calc?
4. Write the steps to a create a sort list containing names of your teachers.
5. Differentiate between absolute and mixed referencing.
6. How do you come to know that filtering has been turned on?
7. In a Calc worksheet containing price and quantity of electronic items, write the steps to sort the data in descending order of cost of items. Also apply filters to price and quantity columns.
8. Give one point of difference between bar chart and column chart.
9. How can you print a chart? Write steps to do so.
10. What is the use of gridlines in a chart?

ANSWERS TO INTEXT QUESTIONS

9.1

1. (i) Standard (ii) Cell (iii) Active Cell (iv) Ctrl + Q (v) 2
2. Uses of spreadsheet application:
   a. They are used to calculate, analyse and store and present the information.
   b. These are very useful in What-if analysis.
   c. Spreadsheets are very useful to manage financial data like stock exchange movements, account transactions etc.
   d. The data in a spreadsheet can be pictorially represented through charts.
   e. Various in-built functions help in easy processing and manipulation of data.
3. Select File → New → Spreadsheet.

9.2

1. (i) F2 (ii) Shift (iii) Formula (iv) = (v) label
2. By clicking on the row number

3. AutoFill feature is used to fill sequential data in the cells to form a series automatically.

4. Overwriting and Partial Modification.

9.3

1. (i) TODAY() (ii) Format (iii) absolute (iv) Pie
   (v) Category (vi) Function Wizard

2. In case of sorting, the data is arranged in ascending or descending order. In filtering, data is selectively displayed based on certain criteria on a column(s).

3. In this type of cell referencing, when the formula is copied from one cell to another in a worksheet, the cell reference or address of the cells being used in the formula automatically changes according to the relative position of the copied formula. For example, A10/5.

4. To merge cells, select the range of cells to be merged and click Merge Cells button on the formatting toolbar.

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10

DIGITAL PRESENTATION

In the previous lesson, you have learnt about spreadsheets software. Now you will learn about digital presentation. A digital presentation helps to present information to a group of people in the form of sequential slides. These slides may contain information in the form of text, graphics, audio or video.

Using digital presentations we can effectively communicate our ideas and share any sort of information with number of people in an organized, systematic and interesting manner. That is why now a days presentations are used in schools for teaching, in offices for giving sales report, profit and loss analysis, explaining the proposal or a scientific theory and other such situations. Some of the presentation software available in the market are MS PowerPoint, Apple Keynotes, OpenOffice Impress, Adobe Persuation etc. In this lesson you will learn about OpenOffice Impress software.

OBJECTIVES

After reading this lesson, you will be able to:

- list the prominent features of OpenOffice Impress;
- create, open, and close a presentation;
- enlist the components of OpenOffice Impress Window;
- insert objects such as text, illustrations, audio and video on a slide;
- add animation and transition effects;
- run the slide show;
- use rehearse timing feature;
- save and print a presentation;
- publish a presentation.

10.1 INTRODUCTION TO IMPRESS

Impress is the presentation software that comes with OpenOffice Suite. Using Impress, we can create slides that contain text, pictures, images, tables, audio and even video elements. We can apply various background themes and colours, text styles, animation and transition effects to enhance our presentations. In this lesson you will be learning OpenOffice Impress (version 4.1.1) to create a presentation. Some of the features of OpenOffice Impress presentation software are as follows:

1. Impress allows us to create and customize the presentation as per our requirements.
2. You can add various illustrations like clipart, pictures, shapes, images, etc., to the slides to enhance its appearance and make it user friendly.
3. Various sound effects and video clips can be added to the presentation.
4. Various animation and transition effects can be added to the slides and also to each individual object on the slide.
5. The presentations created using Impress can be viewed as series of web pages in the browser.
6. The presentational material like handouts, speaker notes, charts, etc., can also be created using OpenOffice Impress.

To start Impress, click **Start** → **All programs** → **OpenOffice 4.1.1** → **Presentations**. The **Presentation Wizard** starts. Using this wizard, you can create a new empty presentation, create a new presentation from in-built templates or open an already existing presentation.

10.1.1 Creating an Empty Presentation

Once the presentation wizard starts, follow the steps given below to create an empty presentation:

1. Select the **Empty Presentation** option from Step-1 of the Presentation Wizard and click **Next** → button (Fig. 10.1).
2. In Step -2 of the Presentation Wizard, select various aspects of designing a slide. From **Select a Slide Design** section, select any one of the design options and the corresponding options will be displayed in the list box below. The preview of the selected background slide will also be displayed. In Fig. 10.2 we have selected *Presentation Backgrounds* option and *Blue with Bottom Title* background option.

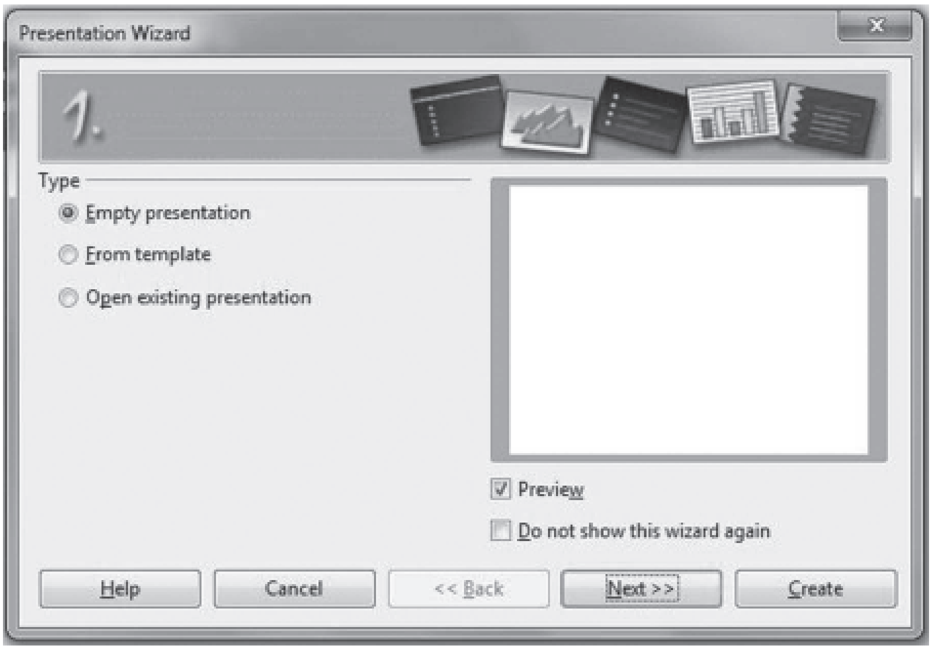


Fig. 10.1: Step-1 of Presentation Wizard

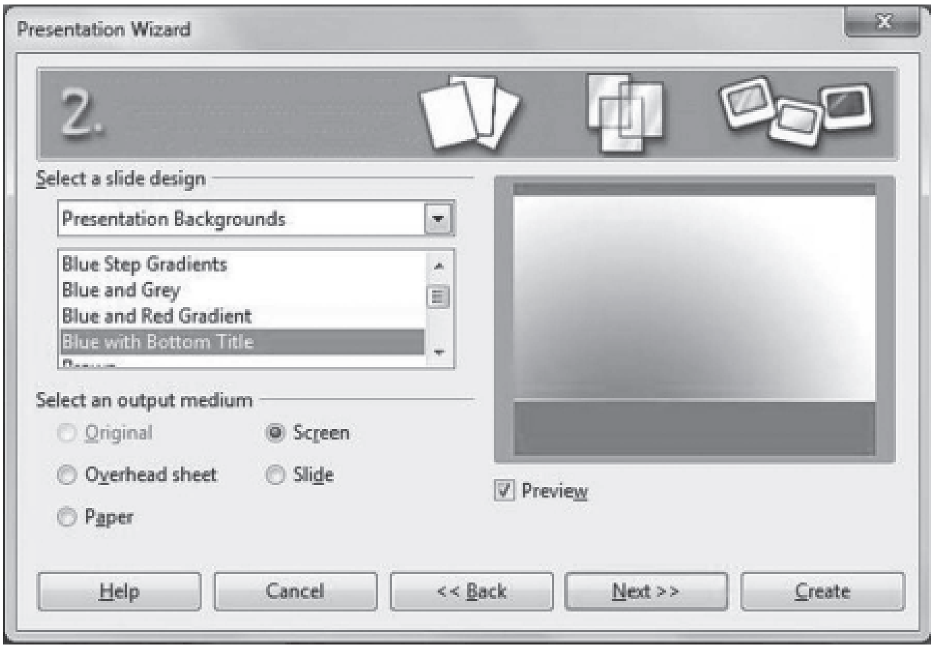


Fig. 10.2: Step-2 of Presentation Wizard

3. From the **Select an Output medium** section, select the medium where the presentation has to be viewed. By default, the **Screen** option is selected. Click **Next** → button.

4. The last step of the wizard allows us to select the transition effect and the speed of transition to be applied to the sildes in the **Select a slide transition** section. From **Select the presentation type** section, the **Default** radio

button is selected. So, the presentation will run manually i.e., on mouse click. However, if we want to run the presentation automatically, click **Automatic** radio button and specify the duration of transition and duration of pause for the slides in the presentation. In Fig. 10.3. we have selected Effect as *Wipe Left*, Speed as *slow* and presentation type as *default*.

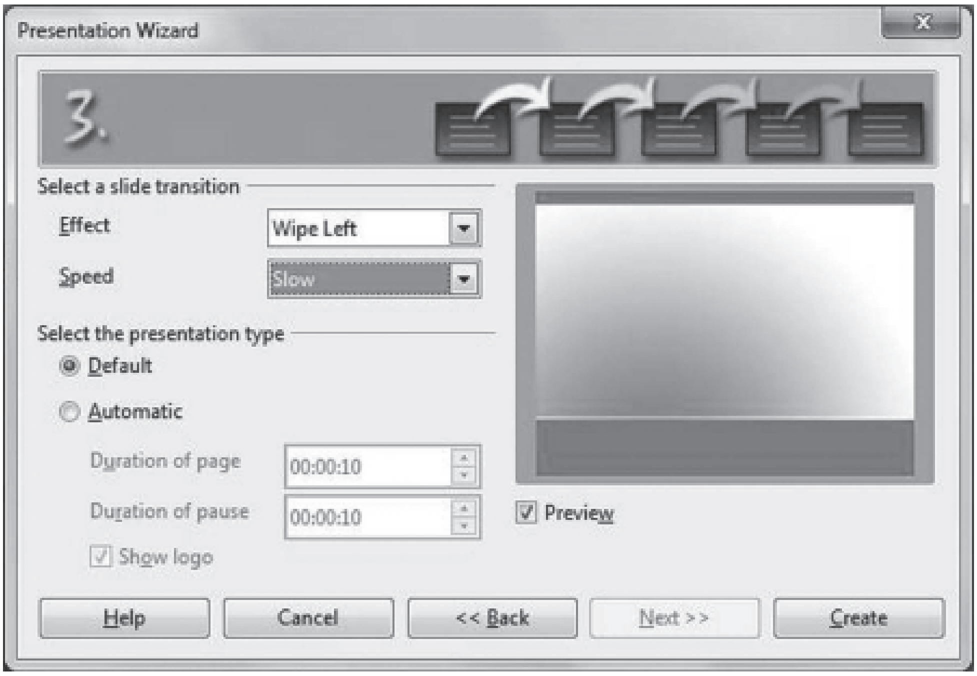


Fig. 10.3: Step-3 of Presentation wizard

5. Click **Create** button. The OpenOffice Impress Window will be displayed as shown in Fig. 10.11.

10.1.2 Creating a presentation from templates

Templates are the pre-designed patterns or formats that are provided by Impress presentation software. These are specific for a particular presentation topic. Each template contains predefined styles such as font face and size, placeholder's size, background colour, text colour etc. Open the Presentation wizard as explained in section 10.1.1 above and then follow the steps given below to create a presentation using Templates:

1. In the Presentation Wizard (Step-1) click **From Templates** radio button. A list box containing various presentation templates appears (Fig. 10.4).

2. Select the desired template and click **Next →** button. In our example we have selected *Introducing a New Product* from the list box.

Notes

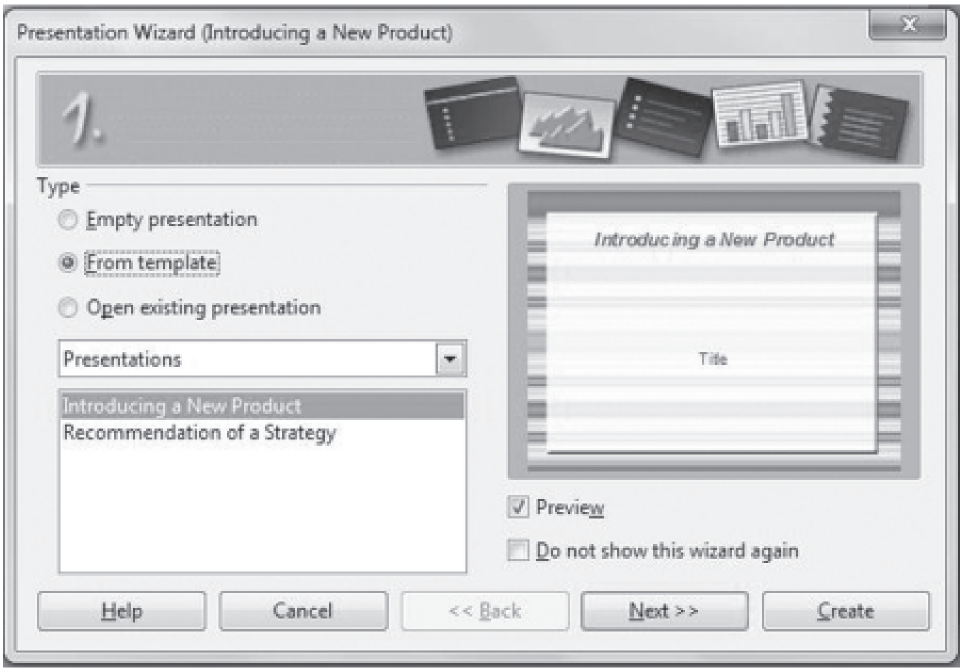


Fig. 10.4: Selecting Templates

3. In Step-2 (Fig. 10.5), select the presentation background colour scheme from **Select a slide design** section. Also, in the **Output medium** section, **Original** option is selected. Click any other option, if required and click **Next** → button.

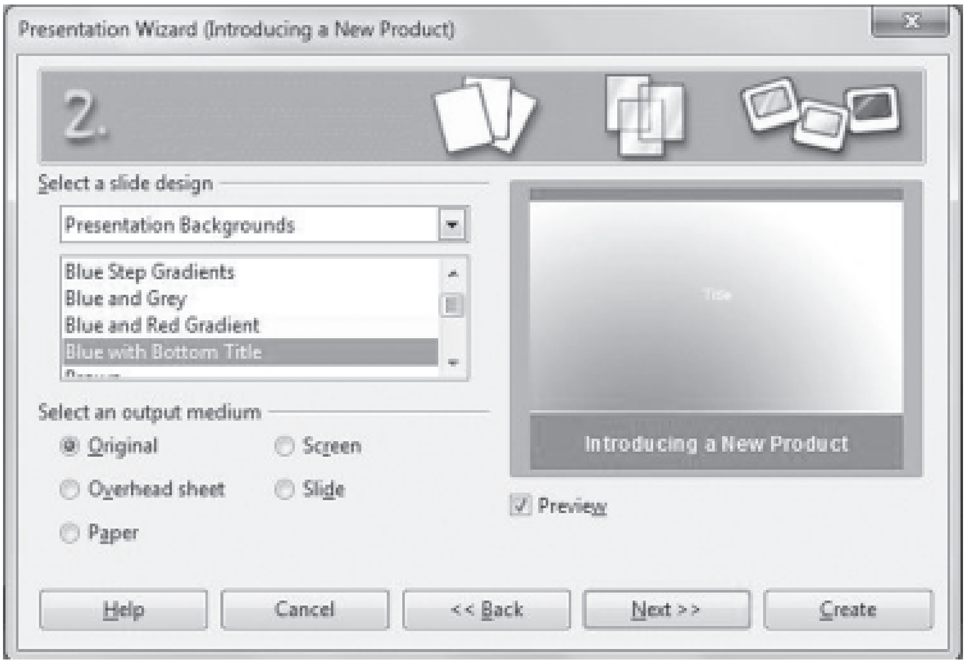


Fig. 10.5: Select the slide design and output medium

4. In Step-3, select the slide transition and speed of transition from the respective list boxes in the **Select a Slide Transition** section.

5. Also select the desired **presentation type - Default or Automatic**. Click **Next** → button.

6. In Step-4, type **name of the company** for which the presentation is being created, **subject of presentation** and also some of the **ideas to be presented** in the presentation, (Fig. 10.6). Click **Next** → button.

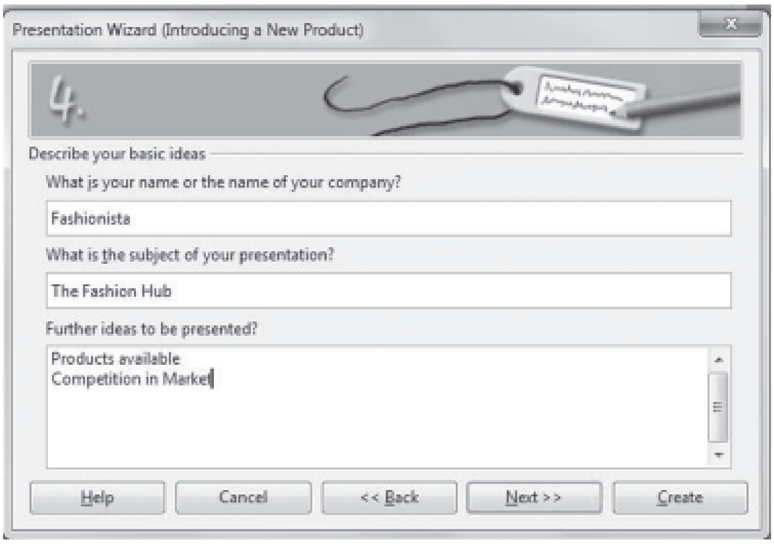


Fig. 10.6: Information about the presentation

7. In Step-5, by default all page options are selected. We may de-select any of them, if required (Fig. 10.7).

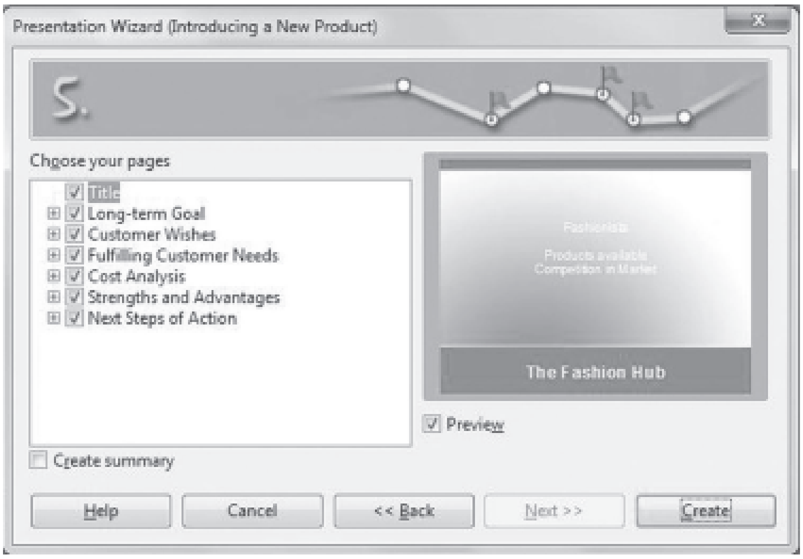


Fig. 10.7: Various page options

8. Click **Create** to create a new presentation from built-in templates (*Introducing a new product*) of Impress.

10.2 OPENING AN EXISTING PRESENTATION

To open an already existing presentation, we can choose **Open existing presentation** option in Step-1 of Presentation Wizard (Fig. 10.8). Thereafter select the name of the file from the list box and click **Open** button.

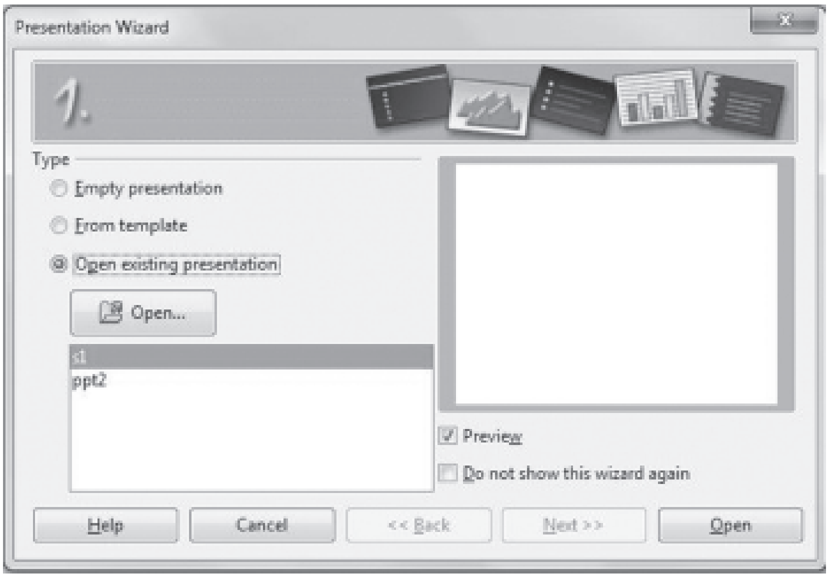


Fig. 10.8: Opening an existing presentation

To open a presentation while Impress is already running, select **File → Open**. The **Open dialog box** will be displayed (Fig. 10.9). Browse for the folder and select the file to be opened. Click **Open** button to open the selected presentation file.

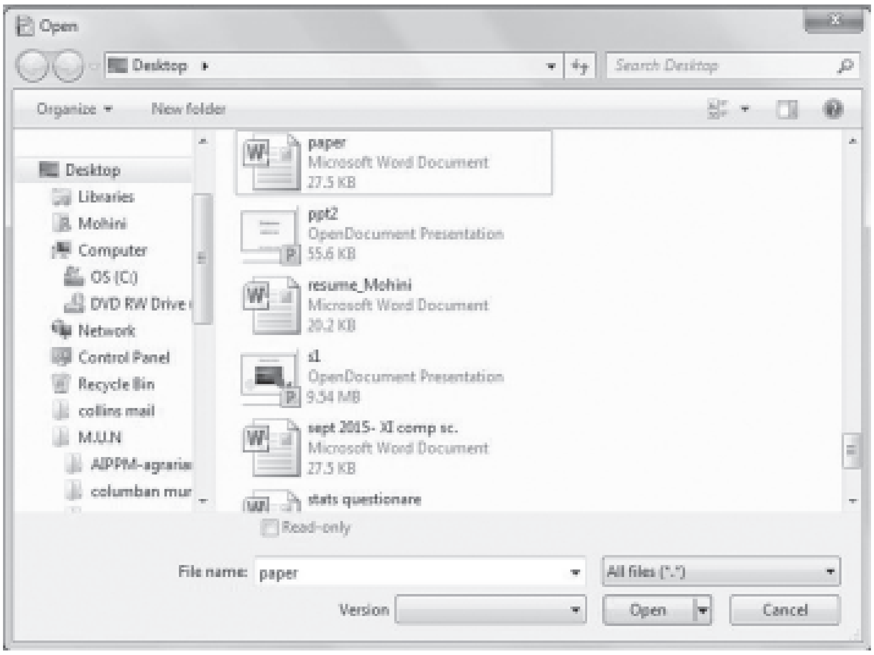
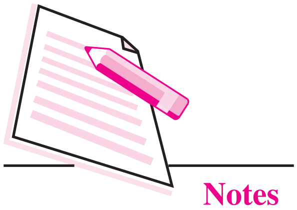


Fig. 10.9: Open dialog box



Notes

10.3 CLOSING A PRESENTATION

After finishing our work, we may close the presentation file without closing Impress application by selecting **Close** option from the **File** menu. If we want to exit Impress, click **Close** button on the top right corner of the Impress Window. Alternatively we can click **File → Exit** option. As we have learnt in previous lesson, if our file to be closed is not saved, then Impress prompts us to save the presentation file by displaying a message box as shown in the Fig. 10.10.

Press Ctrl +Q to exit Writer.

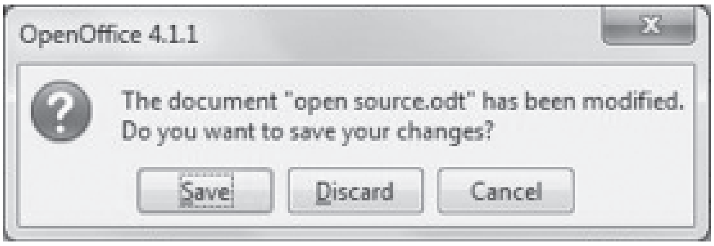


Fig. 10.10: Message Box to Save the presentation

Click **Save** button to save, **Discard** button to close the presentation without saving and **Cancel** button to cancel the closing process and continue working with the current presentation.

10.4 COMPONENTS OF IMPRESS WINDOW

Whether a new presentation is created or an existing presentation is opened, the Impress window as shown in Fig. 10.11 is displayed.

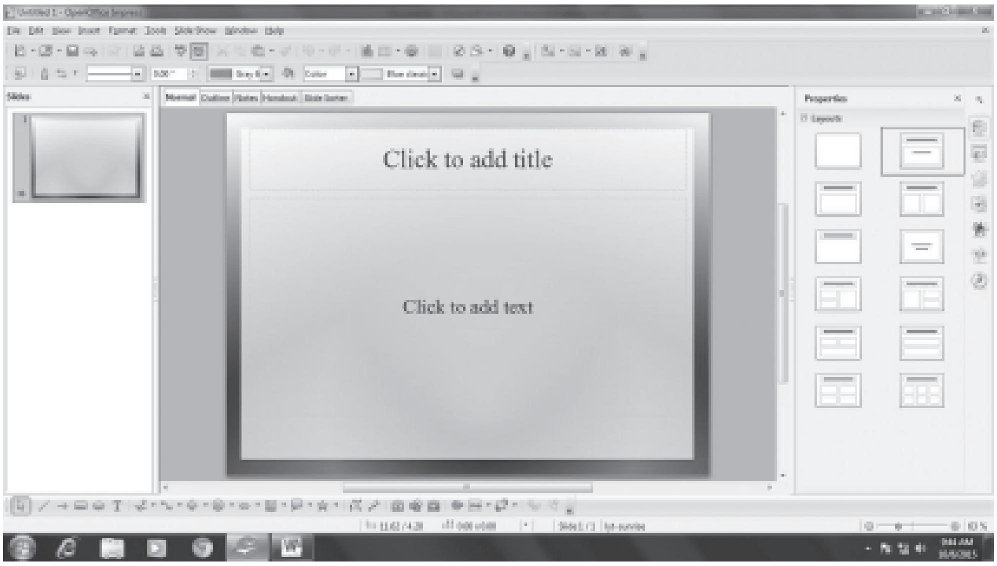


Fig. 10.11: OpenOffice Impress Window

The various components of OpenOffice Impress window are as follows:

- **Title bar:** The title bar is located at the top of the Impress window. It displays the name of the file and the name of the application. The minimize, maximize/restore and close buttons are present on the extreme right of the title bar.
- **Menu Bar:** It is present just below the Title bar and it displays various menus- File, View, Insert, Format, Tools , Slide Show, Window and Help. These menus give access to basic commands used in Impress.
- **Toolbars:** Various toolbars can be displayed while creating or editing a presentation. These toolbars can be viewed by clicking **View→Toolbars** and then selecting the desired toolbar. Some of the toolbars provided by Impress are Standard toolbar, Drawing Toolbar, Line and Filling toolbar etc.
- **Slides Pane:** The Slides Pane is located on the extreme left of the Impress window. It contains thumbnail pictures of the slides in a sequential order. If any of the slides in the slides pane is selected, it appears in the workspace as active slide.
- **Workspace:** The slide on which the objects are being inserted / edited is known as active slide and it appears in the workspace. The objects like text, graphics, audio, video, etc., can be inserted, edited or formatted on this slide in the workspace.
- **Status Bar:** This is present at the bottom of the Impress window and displays the information like number of slides, active slide number, name of the object being selected etc.
- **View Tabs:** Presentation in OpenOffice Impress can be viewed in six views – Normal, Outline, Notes, Handouts, Slide Sorter and Slide Show. The first five views can be selected by clicking on the respective view tabs above the workspace.
- **Docking Tasks Pane:** On the extreme right of the Impress window, there are seven icons (Fig. 10.12). These are Properties, Master Pages, Custom Animation, Slide Transition, Styles and Formatting, Gallery and Navigator. By clicking on any of these icons, the corresponding docking tasks pane opens containing various commands to select the layout, templates, animations and transition effects, format text and graphics, apply various styles, insert pictures and navigate through the presentation slides respectively.

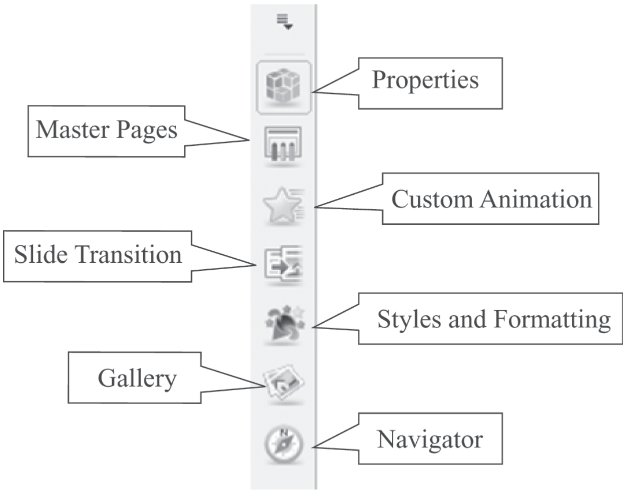


Fig. 10.12: Docking Tasks Pane Icons

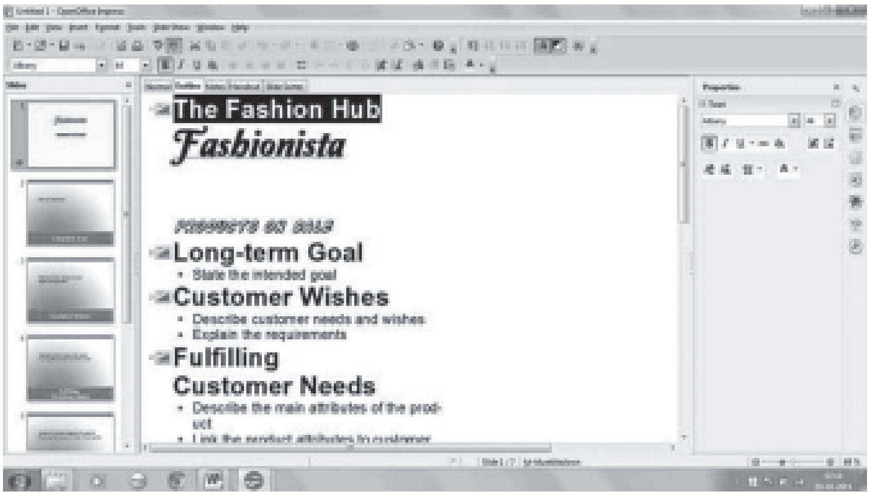
As mentioned before, the presentation created in OpenOffice Impress can be viewed in six different views. These are Normal, Outline, Notes, Handouts, Slide Sorter and Slide Show. Each of these views helps us to view the presentation in distinct manner laying focus on various aspects of the presentation.

- **Normal View:** This is the default view for creating a presentation and it allows us to add text, graphics and other objects to the active slide. We can format and edit objects and also apply animation and transition to the slide in this view.
- **Outline View:** This view shows the summarized version of the slides as it displays only the title and the main text of the slides. All the slides are displayed in numbered sequence. By using outlines, we can easily manage and organize the sequence and flow of our presentation.
- **Notes:** The notes or speaker notes refer to the small pictures of slides along with some descriptive notes at the bottom of each slide. These notes are not seen when the presentation is shown and hence these help the person who is giving the presentation in describing the information given on the slides.
- **Handouts:** Handouts are the smaller versions of slides called thumbnails. Using this view, multiple slides can be printed on a single sheet of paper. When a presentation is created, the handouts are given to the audience so that they have a brief idea of the presentation.
- **Slide Sorter:** This view also shows the miniature slides or thumbnails in sequential manner. It helps us to verify the order of slides. We can cut, copy, paste or change the sequence of the slides in this view.
- **Slide Show:** This view displays the slides in full screen without any toolbars. The presentation is showed to the audience in this view.

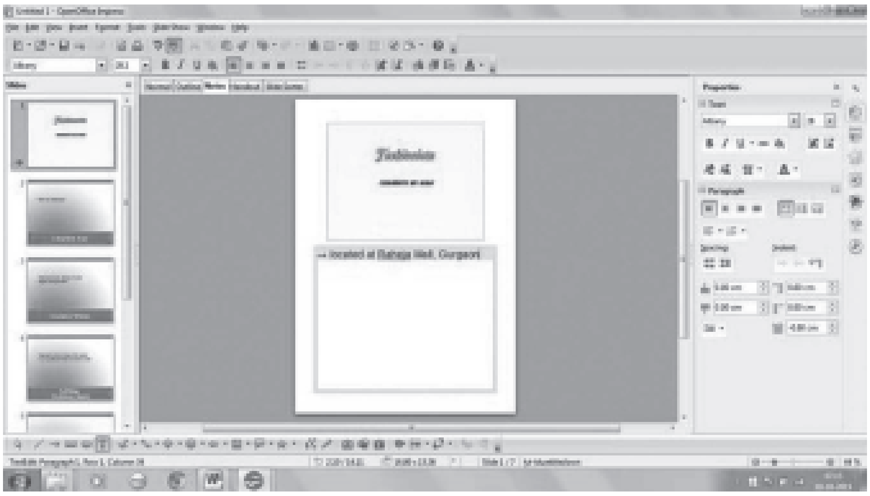
Notes

Fig. 10.13 below shows the presentation in all the views provided by OpenOffice Impress.

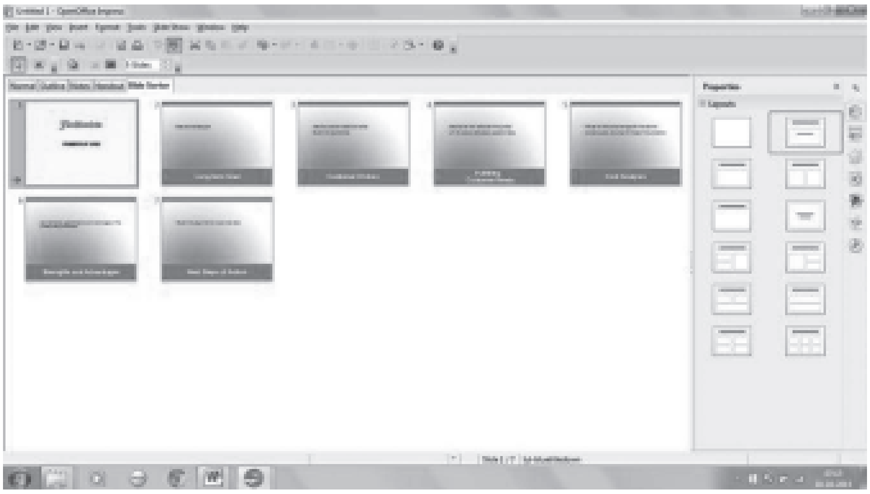
(a) Normal View



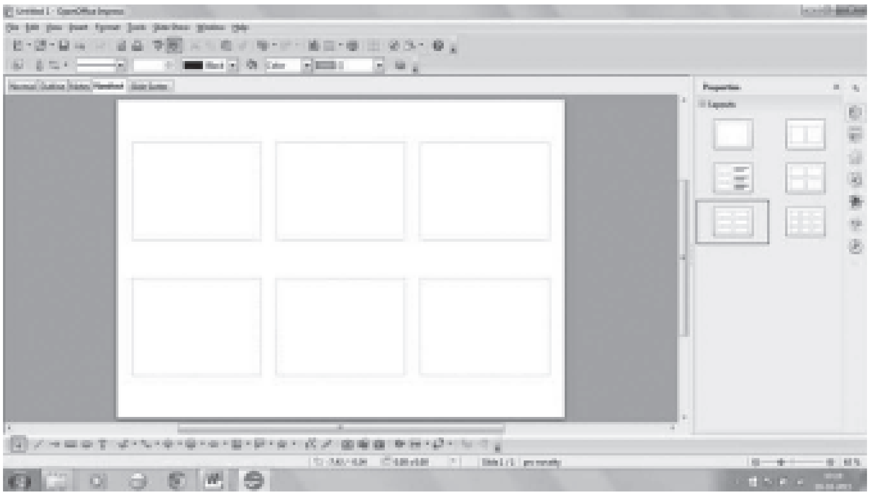
(b) Outline View



(c) Notes view



(d) Slide Sorter view



(e) Handouts view

(f) Slide Show view

Fig. 10.13: Different views of a presentation

Notes

10.5 INSERTING A NEW SLIDE

By default, when we create a new presentation using Empty Presentation option, only one slide exists in the presentation. Generally the first slide is the Title slide, which consists of title and subtitle of the presentation. If required, any other layout can be selected from the **Layouts** section of the **Properties Docking Tasks Pane**.

To add a new slide click **Insert → Slide** option. Alternatively we may right click and select **Slide → New Slide** option from the drop down menu (Fig. 10.14). The empty slide with the selected layout appears in the workspace. The new slide contains placeholders as per the selected layout. Click in the desired placeholder to insert text or graphics.

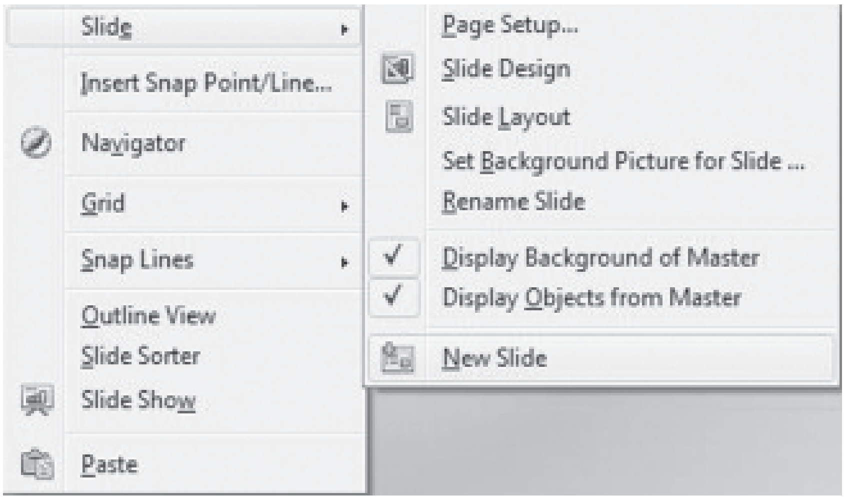


Fig. 10.14: Adding a slide

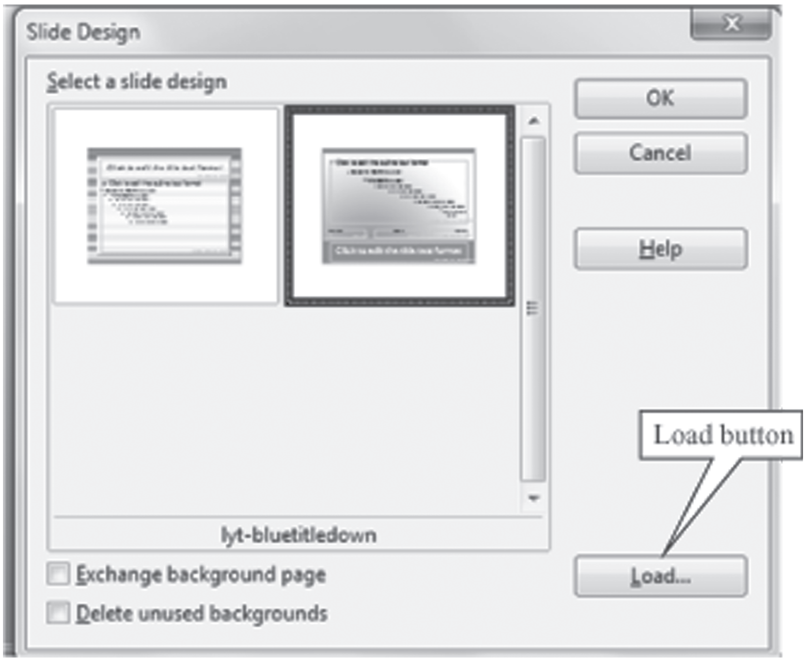
10.6 EDITING AND FORMATTING A SLIDE

A slide can be edited by changing its background colour, applying new built-in templates, adding or deleting objects and so on. Please note that we may make a change in all slides of the presentation or just in one slide.

10.6.1 Using the Slide Master

A slide master is a slide that is used as a starting point for all other slides of the presentation. It has a defined set of characteristics like background colour, text formatting effects, graphic objects etc. To make a global change in the presentation, we just need to make changes in the Slide Master and the changes will be automatically reflected in all the slides of the presentation. Follow the steps given below to select a new design for the presentation:

1. Click **Format** → **Slide Design** option. The **Slide Design** dialog box appears (Fig. 10.15).



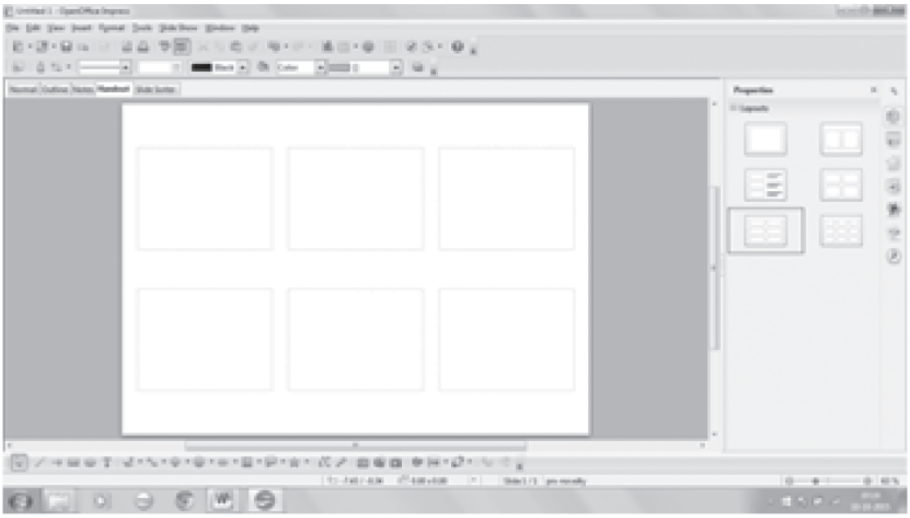


Fig. 10.15: Slide Design dialog box

2. Click **Load** button in the dialog box. The **Load Slide Design** dialog box appears (Fig. 10.16).

3. In the **Categories** section, select the design that you want to apply to the presentation. The corresponding list appears in the **Templates** section. In Fig. 10.16, the *Fresco* style is selected under *Presentation Backgrounds* category.

Notes

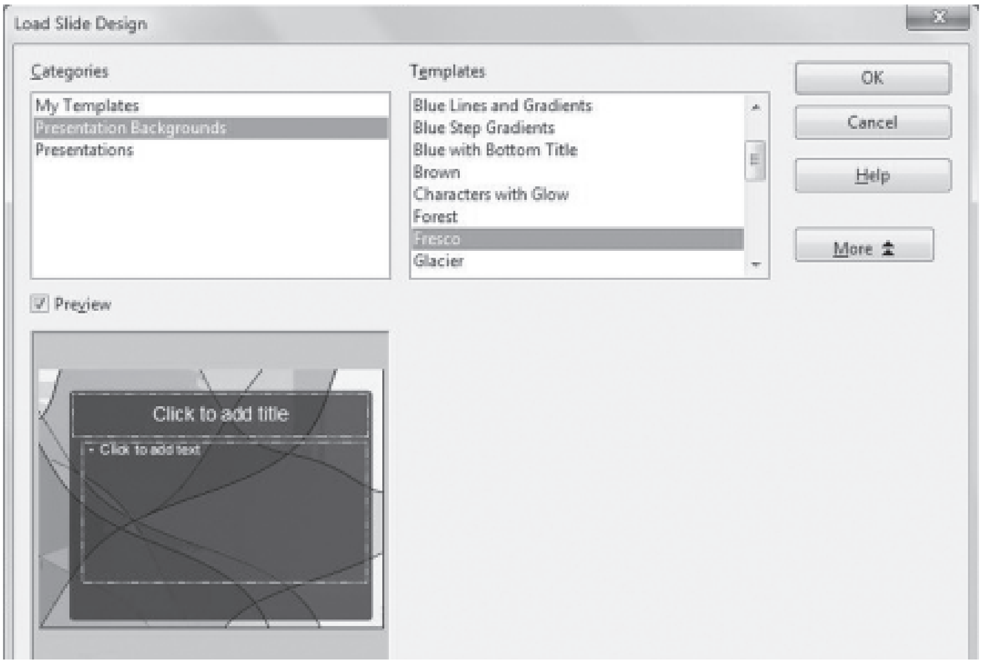


Fig. 10.16: Load Slide Design dialog box

4. Click **OK** button. The **Slide Design** dialog box re-appears with the selected design (Fig. 10.17).

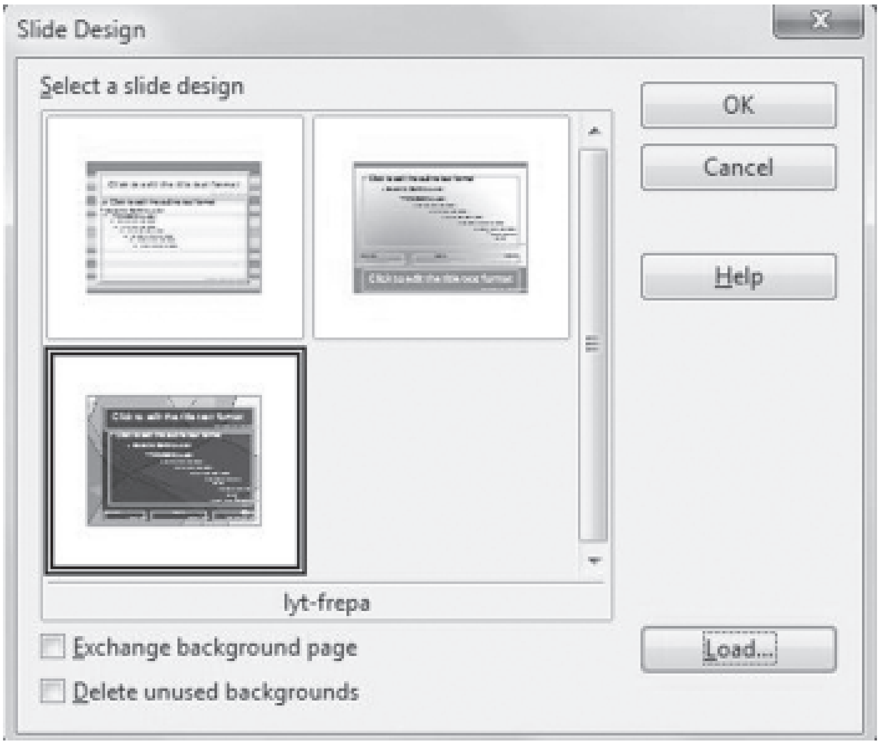


Fig. 10.17: Selected design added in the Slide Design dialog box

5. Click **OK** button. The selected design will be applied to your presentation.

10.6.2 Changing Background Colour

To change the background colour of the slide, follow the steps given below:

1. Select **Format → Page** option. The **Page Setup** dialog box appears (Fig. 10.18).

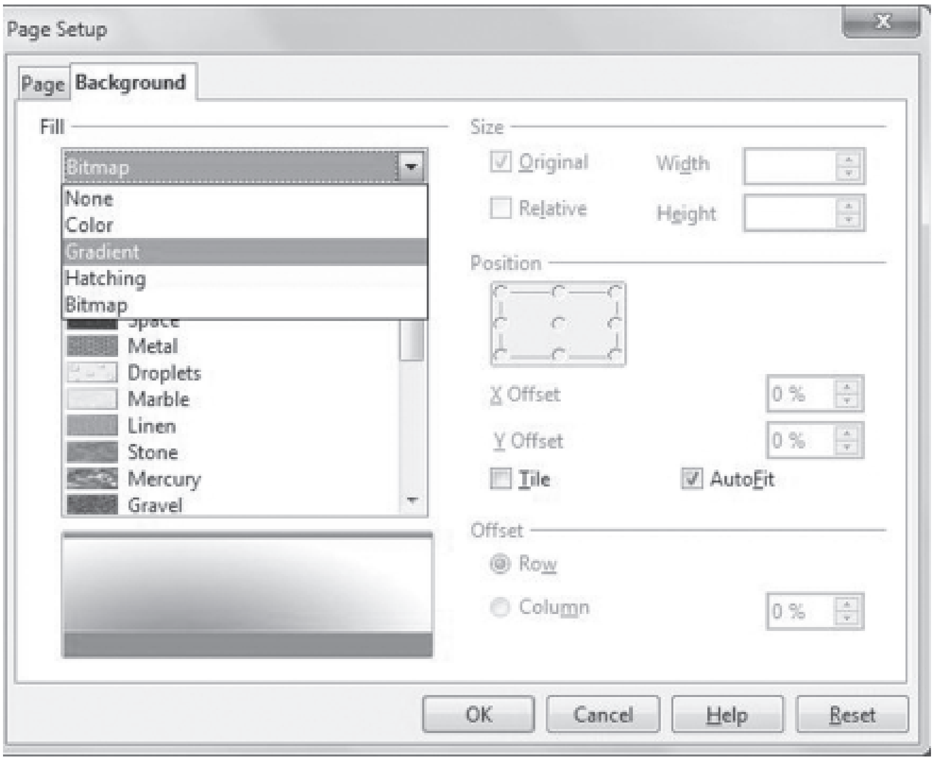


Fig. 10.18: Page Setup dialog box

2. Click the **Background** tab. In the **Fill section**, select the background option, say *Gradient* as shown in the Fig 10.18.
3. Choose the desired colour and click **OK**.
4. The **Page Settings Message box** appears as shown in Fig. 10.19. Click **Yes** if the background colour has to be changed in all slides and **No** if the background colour of only the current slide has to be changed.

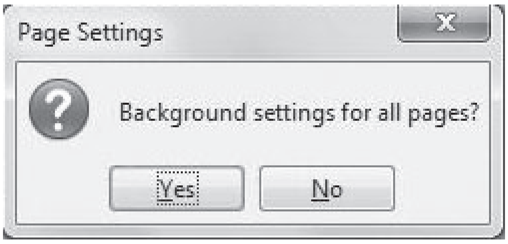


Fig. 10.19: Page Settings Message box

10.6.3 Formatting Text

Formatting text means to change the appearance of the text. To format text in a presentation, open the presentation and select the text whose style is to be formatted. Follow the steps given below to format the selected text:

1. Click **Format** → **Character**. The **Character** dialog box is displayed (Fig. 10.20).

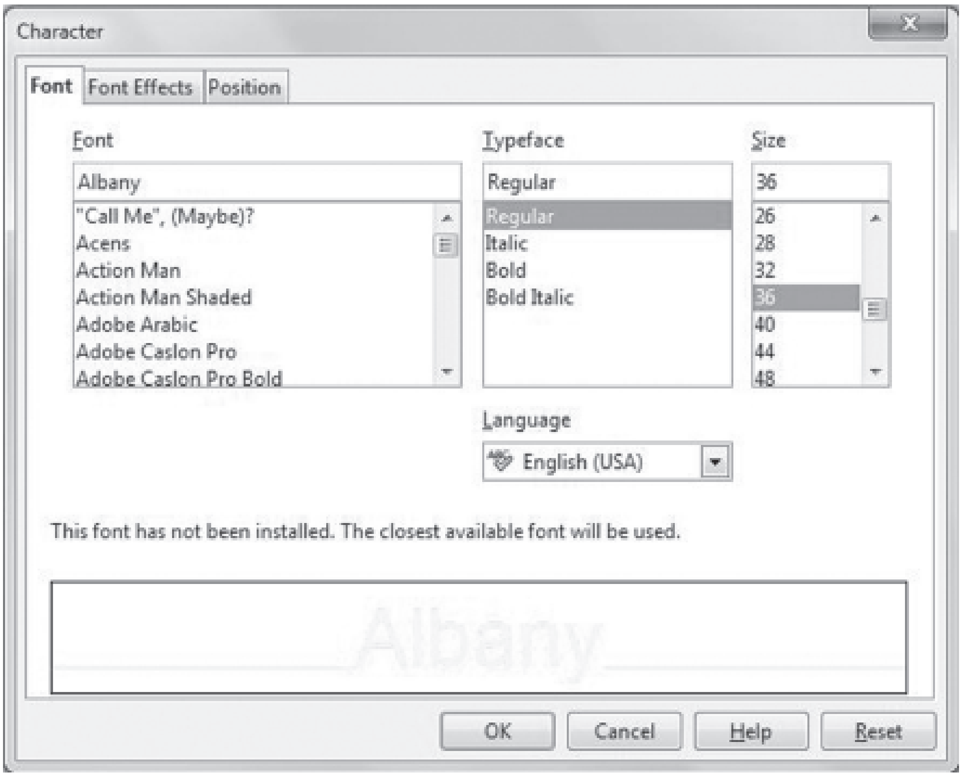


Fig. 10.20: Character dialog box

2. Select the desired font style, size, typeface and click **OK** to apply the selected formatting effects.

The Properties Docking Tasks Pane on the extreme right of the Impress window contains all the formatting commands used to format text and graphic objects on the slide.

10.6.4 Copying and Moving Slides

To copy a slide or move a slide from one place to another, click the **Slide Sorter view** tab. The thumbnail pictures of the slides will be displayed in sequence. Select the slide to be copied or moved. From the **Standard toolbar**, click **Copy** button to copy and **Cut** button to move the selected slide. Click at the place where the slide has to be pasted and click **Paste** button from the Standard toolbar.

10.6.5 Deleting and Hiding Slide

To delete or hide a slide in the presentation, open the Slide Sorter view by clicking the **Slide Sorter** view tab. Right click on the slide that we want to hide or delete (Fig. 10.21). Select **Delete Slide** or **Hide Slide** option. The selected slide will be hidden or deleted as per the selection made by us.

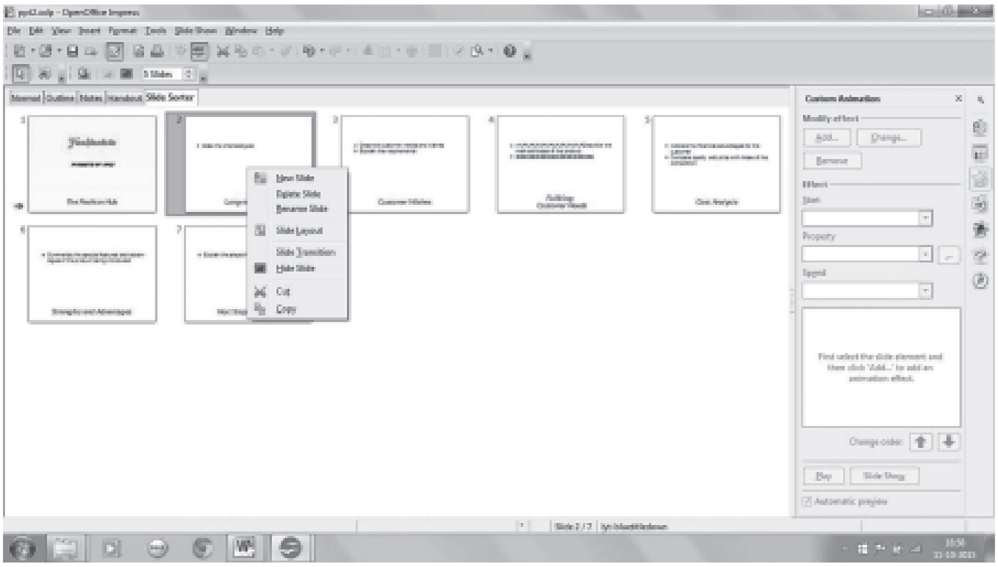


Fig. 10.21: Hiding / Deleting a slide in the presentation

INTEXT QUESTIONS 10.1

1. Fill in the blanks.
   (a) The shortcut key to exit Writer is ....
   (b) The slide on which the objects are being inserted / edited is known as ....
   (c) The .... view displays only the title and main text of the slides.
   (d) A .... is a slide that is used as a starting point for all other slides of the presentation.
   (e) The Slide design option is in .... menu.
2. Give any two features of Impress presentation software.
3. Name the two methods in which a new presentation can be created using Impress.
4. Define a template.
5. Name the presentation views available in OpenOffice Impress.

Notes

10.7 INSERTING ILLUSTRATIONS TO A SLIDE

A good presentation is a mix of text and graphics. To enhance a presentation, various illustrations in the form of pictures, clipart, shapes, etc., are available in OpenOffice Impress.

10.7.1 Inserting Picture in a Slide

Follow the steps given below to insert a picture in a presentation:

1. Open the slide on which the picture has to be inserted.
2. Select **Insert → Picture → From File**. The **Insert Picture** dialog box appears (Fig. 10.22).

Fig. 10.22: Insert Picture Dialog box

3. Browse for the folder where the picture is saved.
4. Select the desired picture and click **Open** button. The selected picture will be inserted on the slide (Fig. 10.23). We can resize the picture using the size handlers present on the edges of the inserted picture.

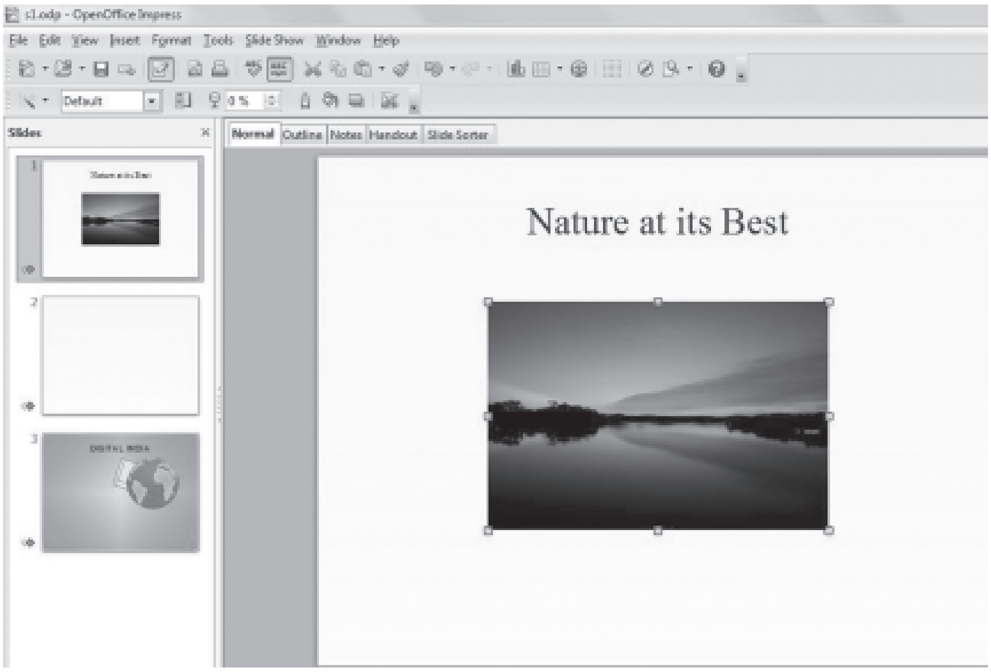
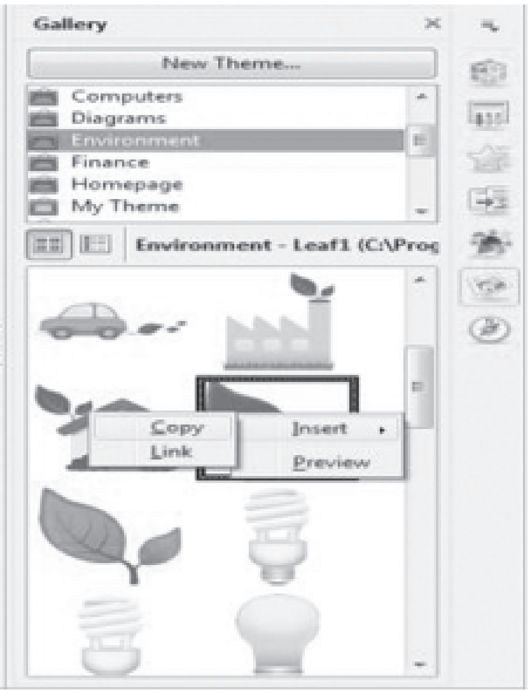


Fig. 10.23: Picture inserted on the slide

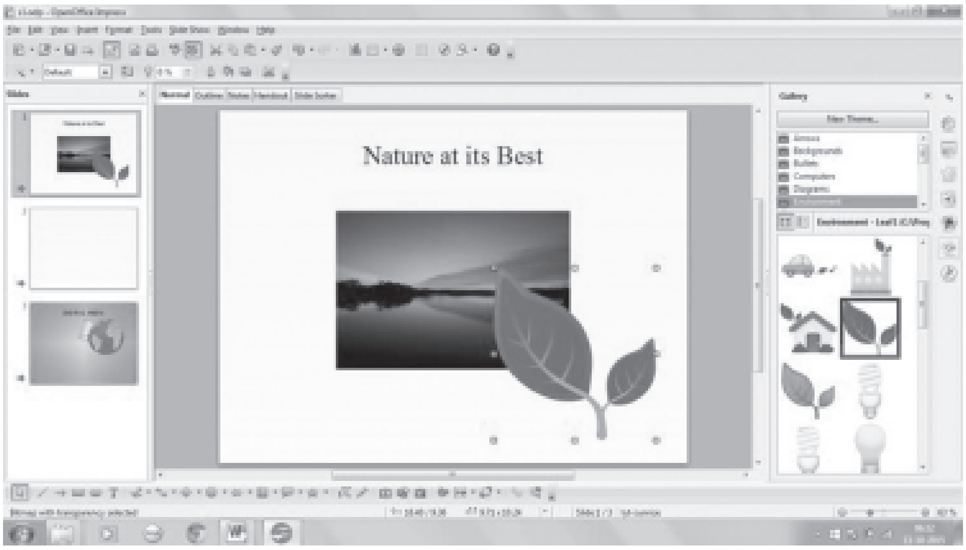
10.7.2 Inserting ClipArt

1. Click the **Gallery** button ( ) on the extreme right of the Impress window. The **Gallery Docking tasks pane** opens up.



(a)

Notes



(b)

Fig. 10.24: Inserting a picture

2. In the **Gallery tasks Pane**, the pictures are categorized according to various themes like Background, Arrows, Environment, etc. On selecting any of the themes from the top of the gallery pane, the corresponding pictures are displayed. Select the desired theme.

3. Right click on the picture that you want to insert and select **Insert → Copy** from the drop down menu (Fig. 10.24(a)). The picture will be inserted on the slide (Fig. 10.24(b)). We can resize the picture by clicking and dragging the size handlers.

10.7.3 Inserting AutoShapes

OpenOffice Impress provides us with a wide variety of graphic shapes like arrows, flowchart symbols, blocks, callouts etc. These shapes can be inserted on the slide using the Drawing toolbar (Fig. 10.25) which is displayed at the bottom of the Impress window. If the Drawing toolbar is not seen, click **View → Toolbar → Drawing** option to display it.

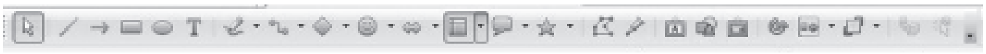


Fig. 10.25: Drawing Toolbar

Follow the steps given below to insert an AutoShape:

1. Open the slide where the AutoShape has to be inserted.

2. In the Drawing toolbar, click the down arrow button beside the desired category viz. Symbols, Flowcharts, Connectors, Curves, Block Arrows etc. Fig. 10.26 shows various shapes available in the Block Arrows category.

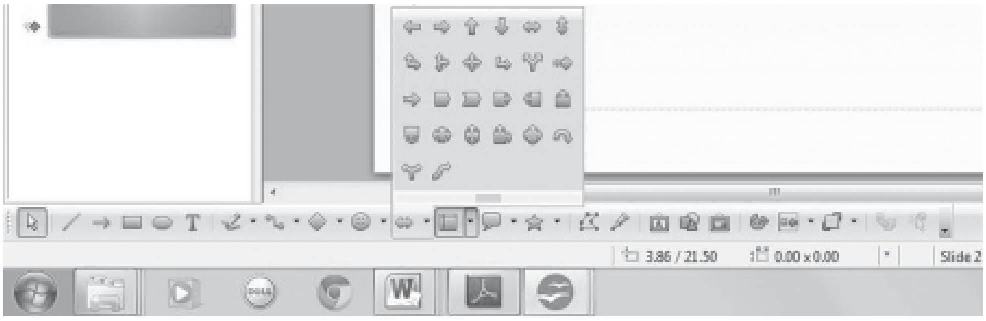


Fig. 10.26: Drawing AutoShapes (Block Arrows)

3. Select the desired shape from the list.

4. Click and drag the mouse pointer on the workspace to draw the selected shape of desired size on the active slide.

10.8 INSERTING AUDIO AND VIDEO

Inserting an audio and video makes a presentation interesting and pleasing to watch.

10.8.1 Inserting audio

Follow the steps given below to insert a music file in the presentation:

1. Select the slide on which any sort of audio has to be inserted.

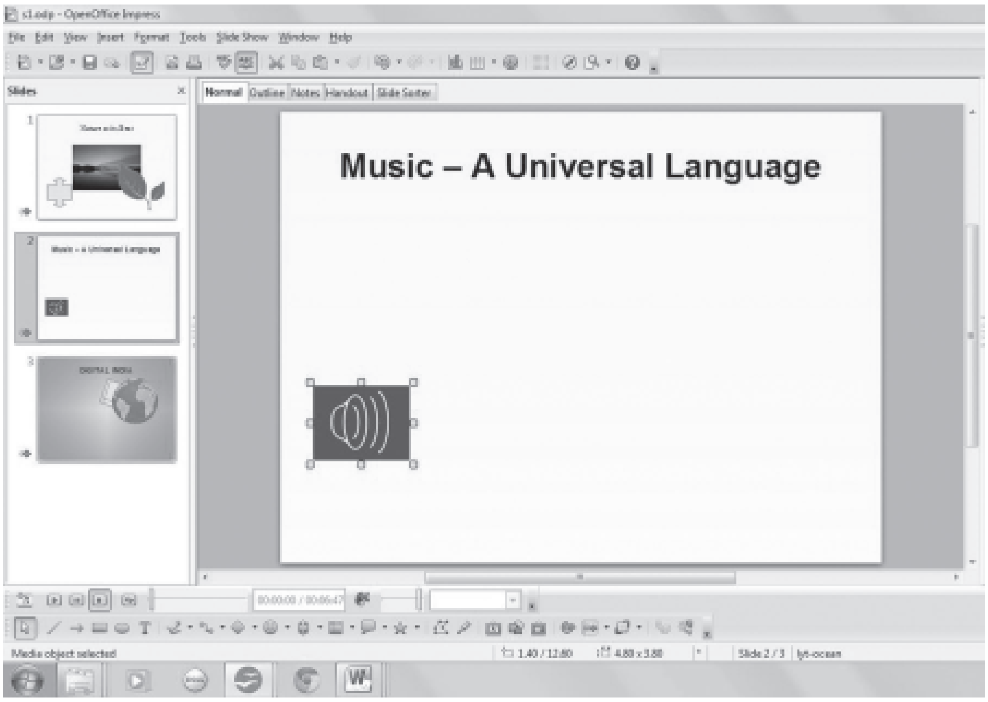


Fig. 10.27: Inserting Music

2. Select **Insert → Movie and Sound** option. The **Insert movie and sound diolog box** appears.

3. Browse for the folder which contains the desired audio file.

4. Select the audio file and click **Open** button. The Music icon appears on the slide and the **Media Playback** toolbar also appears in the Impress window (Fig. 10.27). This toolbar contains commands to play/pause, repeat, volume and other such commands to use the inserted audio file in the desired manner.

Notes

10.8.2 Inserting Video

Follow the steps given below to insert a video file in the presentation:

1. Select the slide on which a video has to be inserted.
2. Select **Insert→Movie and Sound** option. The **Insert movie and sound** dialog box appears.
3. Browse for the folder which contains the desired video file.
4. Select the video file and click **Open** button. The video is embedded on the slide and the **Media Playback** toolbar also appears in the Impress window (Fig. 10.28). You may also resize the video box using size handlers. This toolbar contains commands to play/pause, repeat, volume etc., to view the video in desired manner.

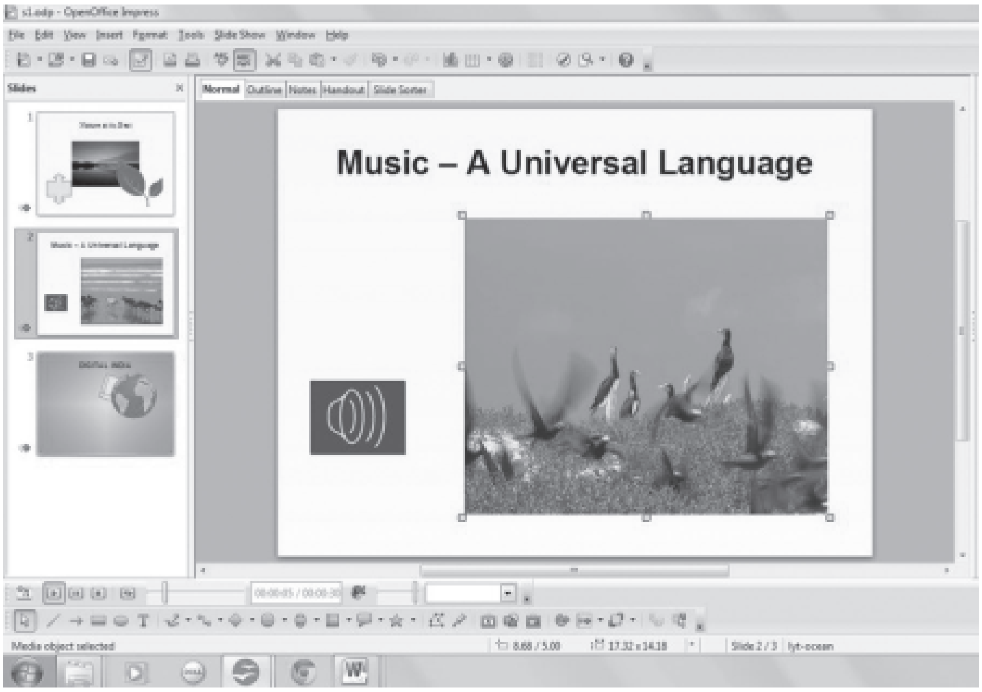


Fig. 10.28: Inserting Video

10.9 ADDING TRANSITIONS

Transitions are the effects that are seen when the presentation moves from one slide to another. OpenOffice Impress provides various types of transition effects which can be applied either on a single slide or on all slides of the presentation. To add transition effects to the presentation, follow the steps given below:

1. Open the presentation and click the slide on which the transition effect has to be applied.

2. Click **Slide Transition button** ( ) on the extreme right of the Impress window. The **Slide Transition docking tasks pane** appears (Fig. 10.29).

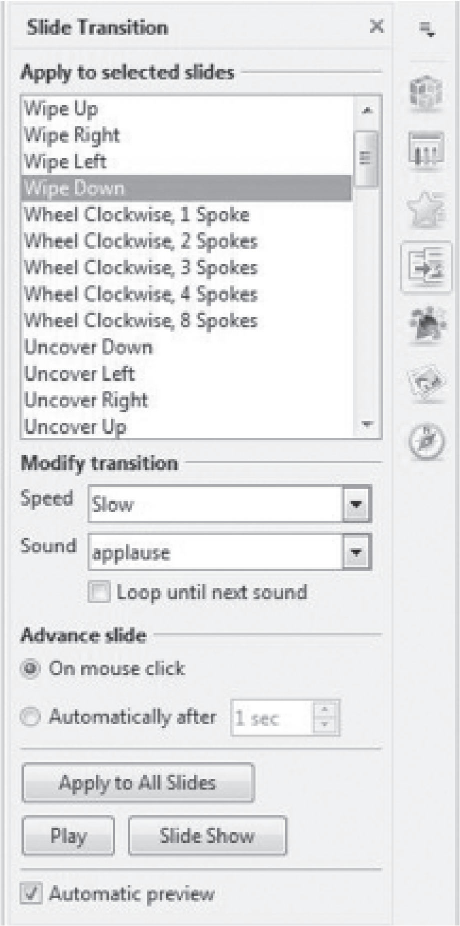


Fig. 10.29: Slide Transition Docking Tasks Pane

3. Select the desired transition style from the **Apply to selected slides** list box. In Fig. 10.29, *Wipe Down* is selected.

4. In **Modify Transition section**, select the desired speed of transition from the **Speed List box**.

Notes

5. In the same section, select the **Sound** alert that has to be played during the selected transition, if required. A sound alert is added to emphasize some points in the presentation.
6. In the **Advance Slide** section, by default, **On Mouse Click** option is selected. This means that while the presentation is running, the slides will be advanced on click of the mouse. If we want that the slide transition should take place automatically, then select the **Automatically After** radio button and specify the time for transition in seconds.
7. Click **Apply to All Slides** button, if the selected transition has to be applied in all slides in the presentation.
8. Click **Play** button to view the applied transition effect in the workspace and **Slide Show** button to view the presentation in full screen.

10.10 APPLYING ANIMATION EFFECTS

An animation is the special effect applied to text, pictures or any other object on the slide. It includes applying sound and visual effects. The animation effects help us to make the presentation more interesting for the audience. To apply animation effects, follow the steps given below:

1. Open the presentation and select the slide whose objects are to be animated.
2. Select the object on which the animation effect has to be applied.

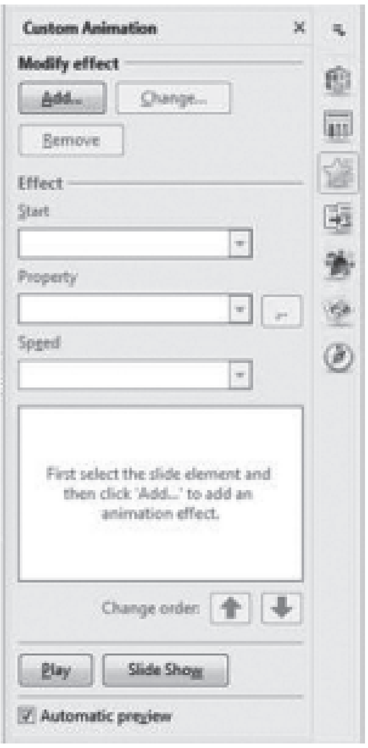


Fig. 10.30: Custom Animation Docking Tasks Pane

Notes

3. Select the **Custom Animation button** ( ) on the extreme right of the Impress window. The **Custom Animation docking tasks pane** appears (Fig. 10.30).

4. In the **Modify Effect** section, click **Add** button to add the animation effect to the desired object. The **Custom Animation** dialog box appears.

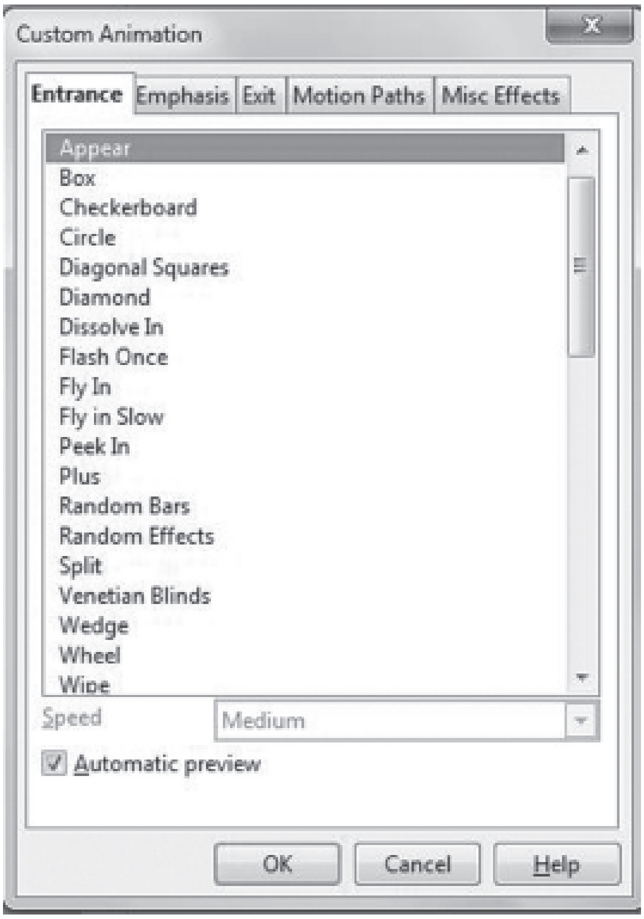


Fig. 10.31: Custom Animation dialog box

5. The **Entrance** tab will be selected. The effects chosen in this tab will be applied when the object appears on the screen. Select the desired effect from the list box. Similarly we may select the **Exit** tab and choose the desired animation effect that will be applied when the object exits from the slide.

6. If desired, repeat the process to apply the animation effects to other objects of the slide.

7. Select the **Automatic Preview check box**(if not selected), so that we can view the selected animation effect in the workspace. Click **OK** button to go back to **Custom Animation** tasks pane. The selected effect will be seen in the Tasks Pane (Fig. 10.32).

Fig. 10.32: Custom Animations tasks pane with selected animation effects

8. From the **Start** list box, select the manner in which the animation will be shown on the slide. In Fig. 10.32 On Click is selected. So the animation will appear when the mouse is clicked.

9. Choose the speed of animation from the **Speed list box** and the direction of transition from the **Direction list box**.

10. The **Change Order buttons** (↑ ↓) are used to set the order in which the objects with animation effects will appear on the slide.

11. Click **OK** button to save the selected animation settings.

12. Click **Play** to view the animation in the workspace and **Slide Show** button to view the slide show in full screen.

10.11 VIEWING SLIDE SHOW

To view the slide show of the presentation, click **Slide Show → Slide Show** option. Alternatively we can also select **View → Slide Show** option. The slide show always appears full screen (Fig. 10.33). No title bar,

The shortcut key to view the slide show is F5.

menu bar or any of the toolbars are displayed while running the slide show. We can exit the slide show by pressing the **Esc** key.

Fig. 10.33: Slide Show

10.12 REHEARSE TIMING FEATURE

Rehearse Timing is a very useful feature of Impress presentation software as it helps us to time our presentation. While practicing the presentation, it records the amount of time that we spend on each slide. Hence we can plan the speed of transition and the animation effects applied to our presentation according to the available time constraints. Perform the following steps to use this feature:

1. Click **Slide Show → Rehearse Timings** option. The Slide show begins with a timer at the bottom left corner of the screen.

Fig. 10.34: Rehearse Timer feature

2. Press the arrow key or click the mouse button to move to the next slide.

10.13 SAVING A PRESENTATION

Follow the steps given below to save the presentation for the first time:

1. Click **File → Save As**. The **Save as** dialog box is displayed (Fig. 10.35).

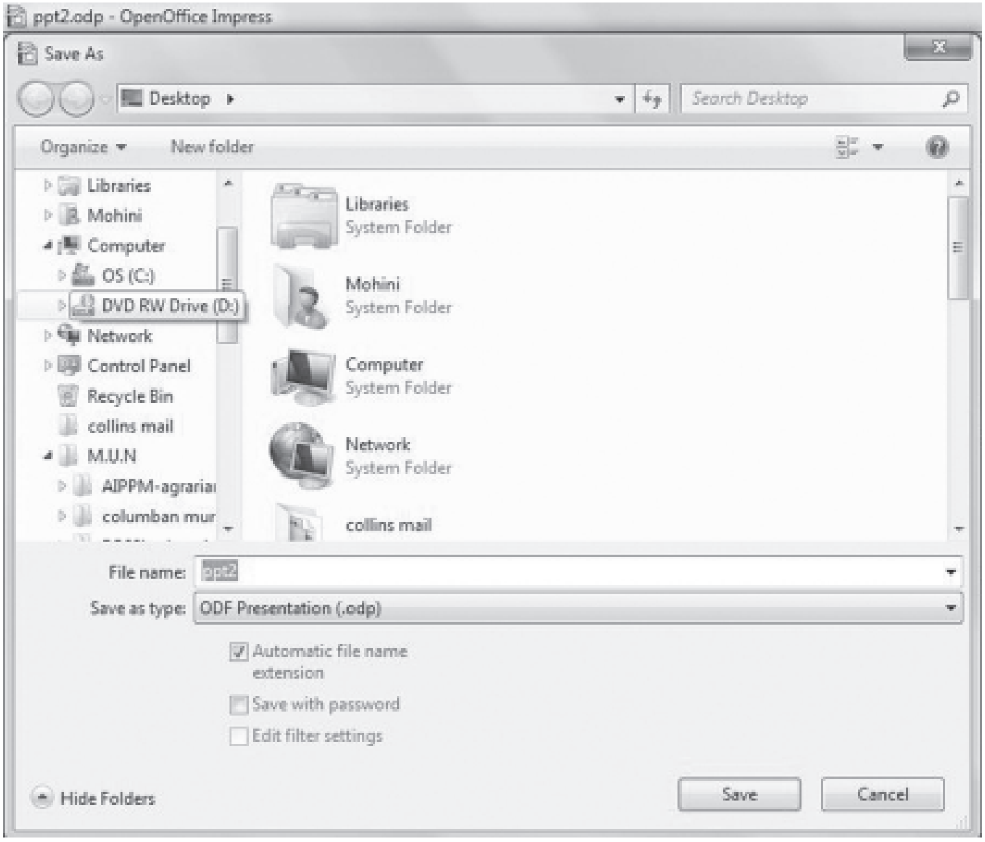


Fig. 10.35: Save As dialog box

2. Browse for the folder in which the file has to be saved.
3. Type the name of the presentation in the **File name** text box.
4. Click **Save** button.

The presentation in OpenOffice Impress is saved with an extension **.odp**. We can also save the presentation by clicking on **Save** button on the Standard toolbar. Please note that the **Save As** dialog box appears only when we are saving the file for the first time. However, if the same file has to be saved with a different name or at a different location, then select **Save As** option again from the **File** menu.

Press Ctrl + Shift +S to save document for the first time and Ctrl+S to save therwise.

10.14 PRINTING A PRESENTATION

OpenOffice Impress gives us the option to print the entire presentation, specific slides, handouts, notes pages or outline pages. Follow the steps given below to print the presentation in any of the available options:

1. Select **File → Print** option. The **Print** dialog box is displayed (Fig. 10.36). The left side of the dialog box shows the preview of the slides along with slide numbers to be printed. On the right side of the dialog box, the **General tab** is selected.

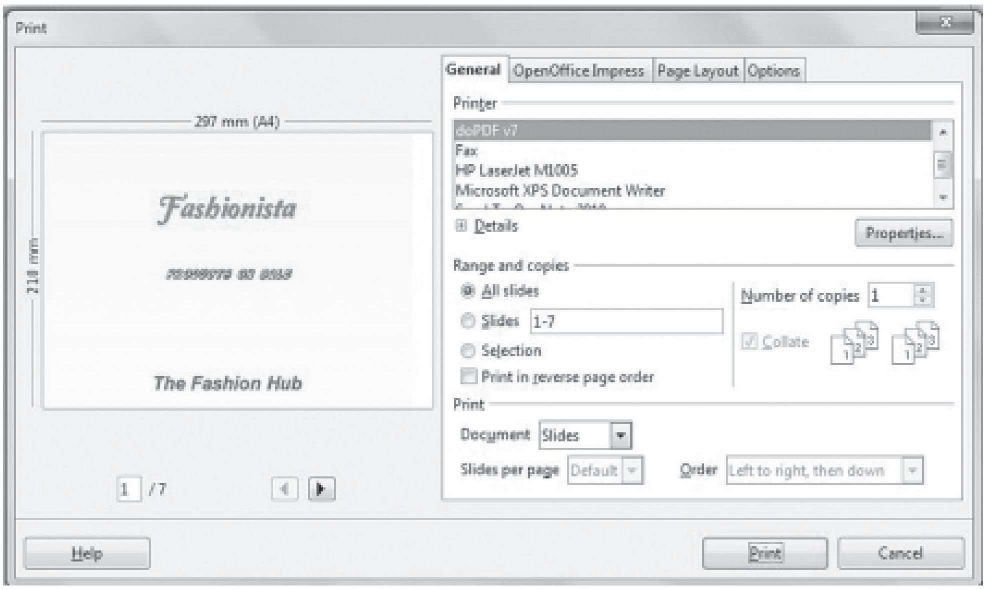


Fig. 10.36: Print dialog box

2. The default printer is selected. Select a different printer if required.
3. In the **Range and Copies section**, specify the range of slides to be printed – All Slides, Selected Slides or Current Slide.
4. Choose the number of copies that are to be printed.
5. In the **Print section**, choose whether we want to print complete slide, handouts, notes or outline of the presentation. In case we select handouts, then we have to specify the number of handouts to be printed per page and the order in which they should be printed.

Press Ctrl + P to open the Print dialog box.

6. Click **Print** button to start the printing process.

10.15 PUBLISHING A PRESENTATION

Publishing a presentation means to convert the presentation into a series of web pages. A presentation created in OpenOffice Impress can be published and viewed in the browser. Depending on the size of the presentation and the number of graphic objects it contains, many HTML and image (JPG,GIF or PNG) files are created while publishing the presentation. That is why it is advisable to create a separate folder so that all these files are saved in that folder.

Notes

Follow the steps given below to publish a presentation:

1. Create a folder on your desktop, say *Publish folder* where our presentation and the related objects will be saved in the form of web pages.
2. Open the presentation that is to be published, say *s1.odp*.
3. Click **File → Export** option. The **Export** dialog box will be displayed.

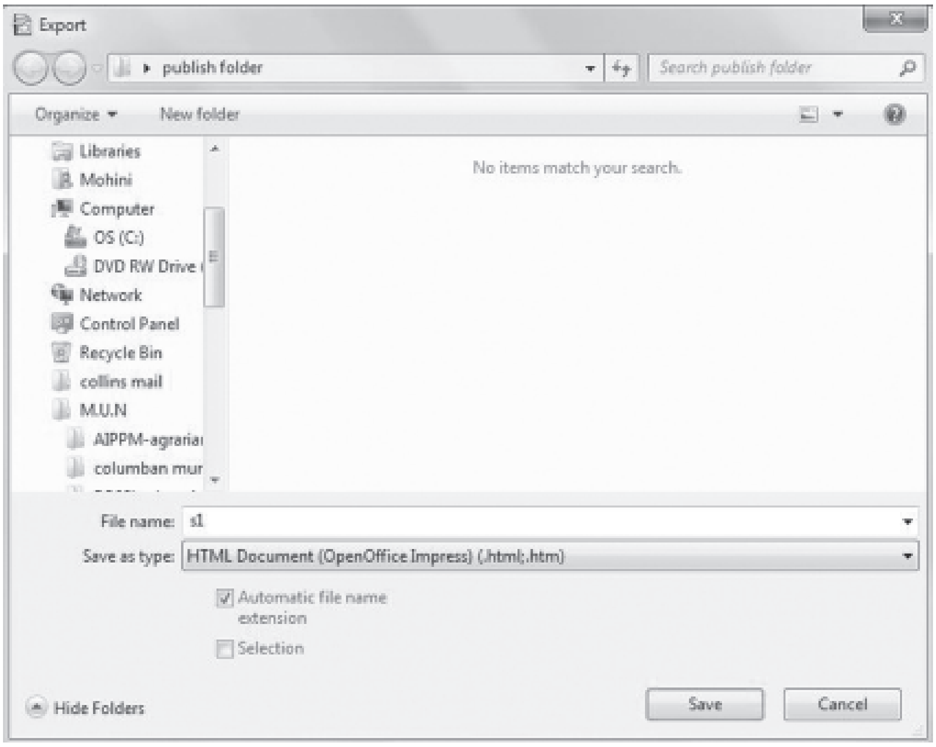


Fig. 10.37: Export dialog box

4. Browse for the folder that was created in Step-1 to save the web pages i.e. *Publish folder.*
5. The **File name** text box contains the name of the presentation (*s1.odp* in Fig.10.37). In **Save as type** list box, select *HTML Document(OpenOffice Impress) (.html, .htm)* option.
6. Click **Save** button. The **HTML Export wizard** starts (Fig. 10.38).
7. The **New Design** radio button is selected. If we wish to select from a previously saved design, click **Existing design** radio button and then select the design name from the list box. Click **Next →** button.
8. The next step allows us to select the publication type of web pages. By default, the **Standard HTML format** radio button is selected. On the right side we have an option to create title page. Check this if you want to specify the information about author (details are given in step 10), **Click Next →** button.

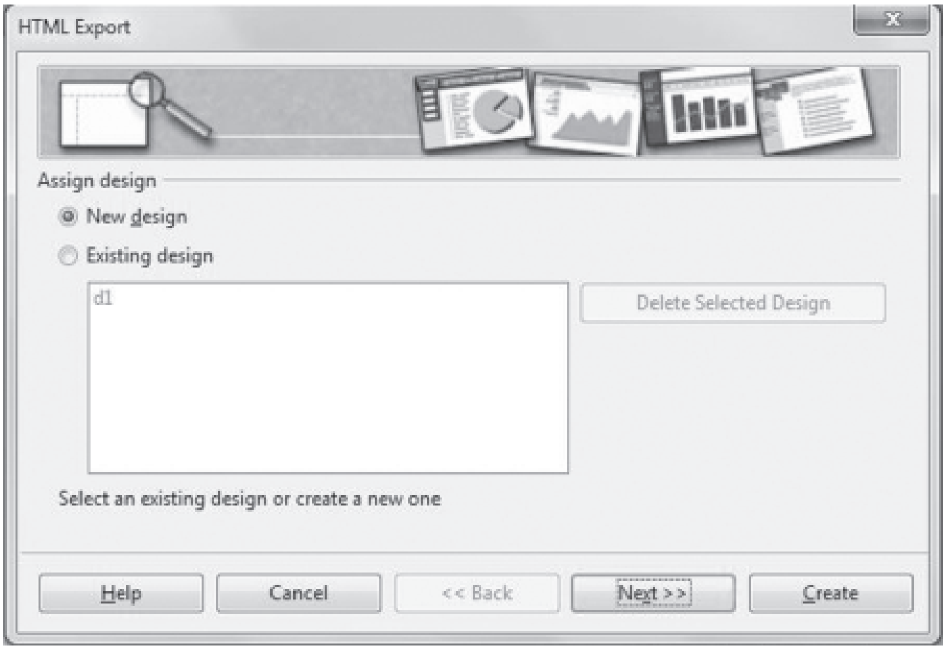


Fig. 10.38: HTML Export wizard (Specifying the design)

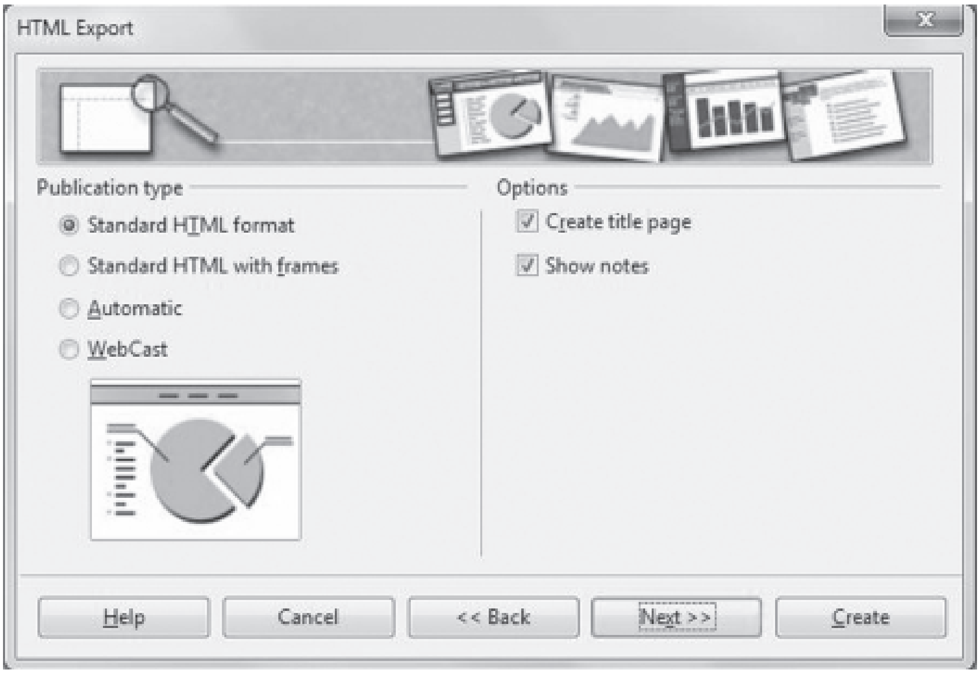


Fig. 10.39: Selecting the publication type

9. Select the format in which the images are to be saved – PNG, GIF or JPG. Also select the desired resolution in which the slide will be displayed. By default, image format **PNG** and **Low resolution (640 × 840 pixels)** of monitor is selected. If required, change the options and click **Next →** button.

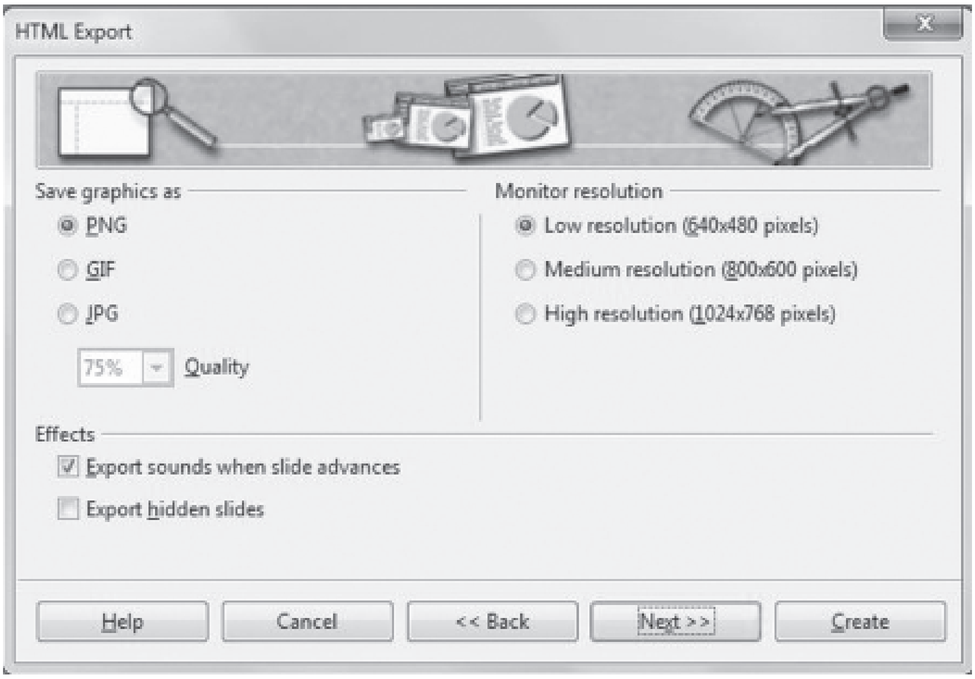


Fig. 10.40: Selecting image format and resolution

10. Specify the information to be displayed on the title slide of the presentation that will be displayed in the browser. Specify the author name, e-mail address, name of the home page and any other additional information that has to be included. Please note that this step of the wizard will not be displayed if **Create Title page** option was not selected in Step-2 of the HTML Export wizard. Click **Next** → button.

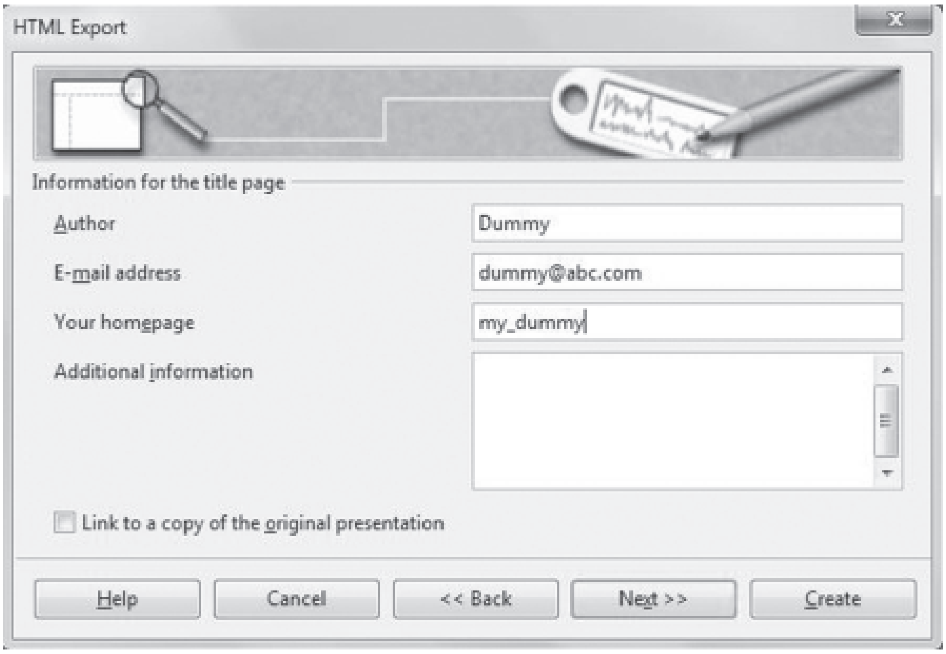
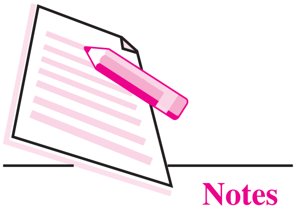


Fig. 10.41: Information for title slide



Notes

11. Select the style of navigation buttons that will be used to move the presentation from one page to another. Click **Next** → button.

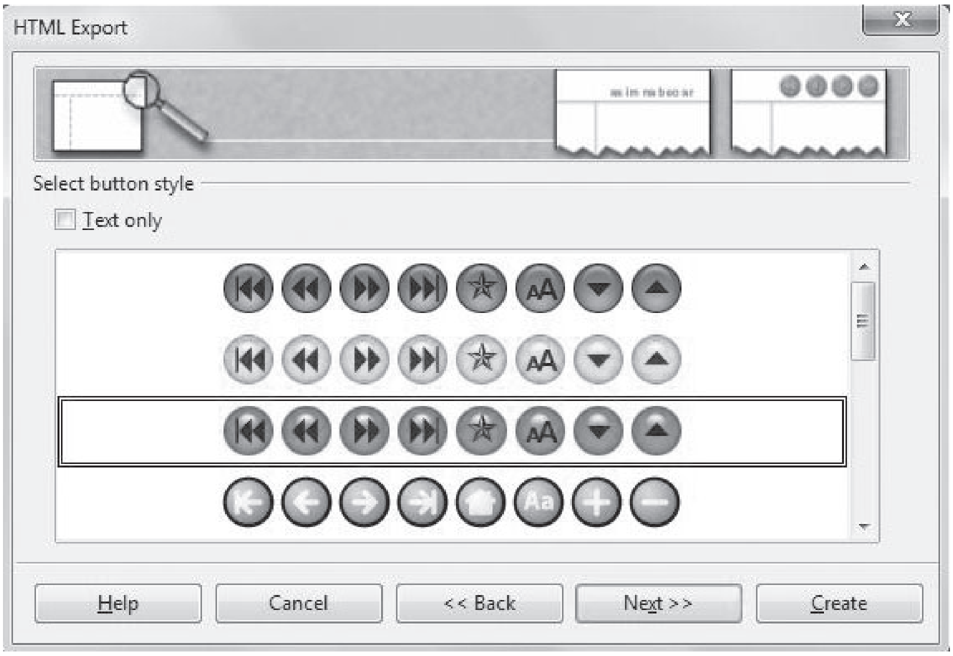


Fig. 10.42: Selecting the navigation buttons

12. Select the colour scheme of the web pages that will be created. By default, **Apply color scheme from document** option is selected. We may choose to select **browser colors** or may create a completely new user defined **custom colour scheme**. We go with the default option and click **Create** button to generate the HTML files.

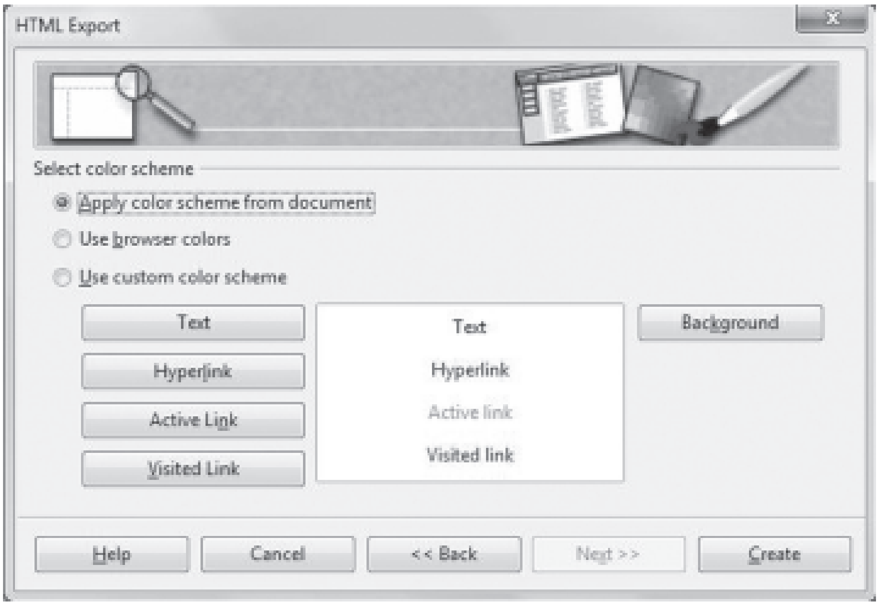


Fig. 10.43: Applying color scheme from document

Notes

13. The **Name HTML Design** dialog box appears. If we want to save the new design, type the desired name in the text box and click **Save** button. Otherwise click **Do Not Save** button. If new design of the web page is created, we may save it so that it may be used again by selecting on the first page of the HTML Export wizard.

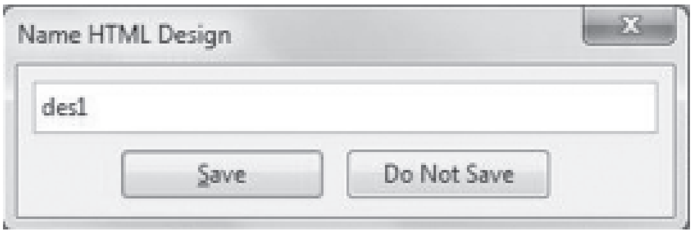


Fig. 10.44: Name HTML Design dialog box

The presentation has now been published. To view it in the web browser, double click the folder that was created to save the HTML files. In our example, it was the *publish folder*. Various HTML and image files will be seen in that folder. Look for the presentation file that we saved as HTML document (s1 in our example) and double click to view it. The title page (if created) will be displayed in the web browser as shown in the Fig 10.45.

Fig. 10.45: Title Page of the published presentation

The title page contains names of all slides in the presentation along with the personal information that was specified in the HTML Export wizard. To start viewing the presentation, click on **Click Here to start** hyperlink. The presentation will start running in the browser (Fig.10.46). The navigation control buttons, as per the selected design will also be displayed in the browser to help us navigate through the slides of the presentation.

Notes

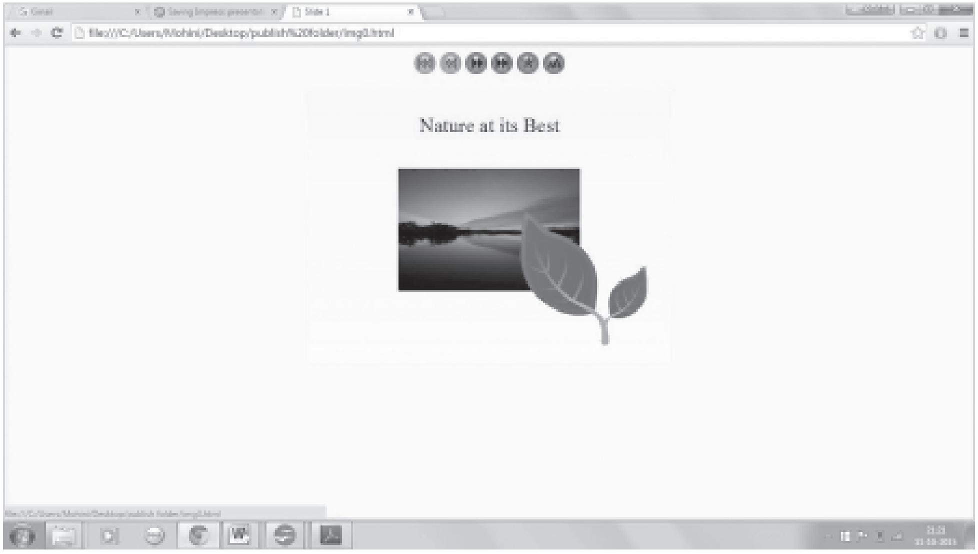


Fig. 10.46: Presentation in the browser

INTEXT QUESTIONS 10.2

1. Fill in the blanks:

   a. A good presentation is a mix of .... and ....

   b. The AutoShapes can be inserted on the slide using the .... toolbar.

   c. The .... toolbar appears when any audio or video is inserted on the slide.

   d. The Rehearse Timings option is available in .... menu.

   e. .... are the effects that are seen when the presentation moves from one slide to another.

2. Write the steps to insert a picture in your slide.

3. What is the use of Rehearse Timing feature in a presentation software?

4. What do you mean by publishing a presentation?

WHAT YOU HAVE LEARNT

- Impress is the presentation software that allows us to create and customize the presentation as per our requirements.
- A slide can be edited by changing its background color, applying new built-in templates, adding or deleting objects and so on.

- A slide master is a slide that is used as a starting point for all other slides of the presentation.
- Transitions are the effects that are seen when the presentation moves from one slide to another.
- An animation is the special effect applied to text, pictures or any other object on the slide. It includes applying sound and visual effects.
- A presentation created in OpenOffice Impress can be published and viewed in the browser.

TERMINAL EXERCISE

1. Name any three presentation software.
2. Write the steps to create an empty presentation in Impress.
3. Differentiate between Notes view and Handouts view of a presentation.
4. Write the steps to insert a video in the presentation.
5. What do you mean by Slide Transition? How is it different from animation?
6. Write the steps to add same transition effect to all slides.
7. You want to print handouts for your presentation. What steps will you follow?
8. What do you mean by publishing a presentation? Write the steps to publish the presentation in OpenOffice Impress.

ANSWERS TO INTEXT QUESTIONS

10.1

1. (a) Ctrl + Q (b) Active slide (c) Outline
   (d) Slide Master (e) Format
2. (a) We can add various illustrations like clipart, pictures, shapes, images etc., to the slides to enhance its appearance and make it user friendly.
   (b) Various sound effects and video clips can be added to the presentation.
3. Empty presentation and presentation using templates
4. Templates are the pre-designed patterns or formats that are provided by Impress presentation software.
5. Normal, Outline, Notes, Handouts, Slide Sorter and Slide Show.

Notes

10.2

1. (a) text, graphics (b) Drawing (c) Media Playback
   (d) Slide Show (e) Transitions
2. (a) Open the slide on which the picture has to be inserted.
   (b) Select **Insert → Picture → From File**. The **Insert Picture dialog box** appears.
   (c) Browse for the folder where the picture is saved.
   (d) Select the desired picture and click **Open** button. The selected picture will be inserted on the slide.
3. Rehearse Timing is a very useful feature of Impress presentation software as it helps us to time our presentation. While practicing the presentation, it records the amount of time that we spend on each slide. Hence we can plan the speed of transition and the animation effects applied to our presentation according to the available time constraints.
4. Publishing a presentation means to convert the presentation into a series of web pages.

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11

OPEN SOURCE RESOURCES

In the previous lesson you have learnt about digital presentation. In this lesson you will learn about open source resources. Open source refers to a program in which the source code (i.e., the executable computer program) is generally available to the general public for use or modification from its original design. Open source is created by the efforts of programmers and organisations which improve upon a code, find glitches, add features etc., and share the changes within the community to be reviewed and used. In this lesson you will learn about usability of open source, benefits of open standards and industry standards, commercial benefits of open standards and database management system.

OBJECTIVES

After reading this lesson, you will be able to:

- use Open Source;
- list the benefits of Open Standards and Industry Standards;
- commercial benefits of Open Standards.

11.1 USE OF OPEN SOURCE

The inspiration for open source is considered to be different from the otherwise paid proprietary softwares and programs previously available through large companies. These companies owned the softwares, which were available to the users at a price and in the limits of certain terms and conditions.

Notes

Open source made a revolution in programming and the software industry by providing new and exciting products free of cost. The primary motive to generate an open source code is to have more useful, bug free products which are easily available and can be tinkered with, according to the requisites of the user.

A certification standard issued by the Open Source Initiative (OSI), indicates that the source code of a computer program is made available free of charge to the general public.

An "OSI Certified" product means that it must meet the following criteria:

- The author or holder of the license of the source code cannot collect royalties on the distribution of the program.
- The distributed program must make the source code accessible to the user.
- The author must allow modifications and derivations of the work under the program's original name.
- No person, group or field of endeavor can be denied access to the program.
- The rights attached to the program must not depend on the program's being part of a particular software distribution.
- The licensed software cannot restrict on other software that is distributed with it. Similar to the certification standards, Open source has its own distribution terms which the product must comply to.
- **No restriction for selling:** The license shall not restrict any party from selling or giving away the software as a component. The license shall not require a royalty or other fee for such sale.
- **Source Code:** The program must include source code; the source code must be in the form in which a programmer would modify the program.
- **Derived Works:** The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.
- **No Discrimination:** The license must not discriminate against any person or group of persons. For example, it may not restrict the program from being used in a business, or from being used for generic research.
- **Distribution of License:** The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.
- **No Restriction with Other Software:** The license must not place restrictions on other software that is distributed along with the licensed software.

11.2 OPEN STANDARDS

An open standard refers to the standard that allows full public assessment and can be used without constraints in unbiased form. They are free from legal or technical clauses that limit its utilization in any business model. It can be managed and further developed independently. It allows you to share all kinds of data freely and with perfect reliability.

Open standards provide several benefits:

- Application Independence: To ensure that access to resources is not dependent on a single application.
- Platform Independence: To ensure that access to resources is not restricted to particular hardware platforms.
- Long-term Access: To ensure that quality scholarly resources can be preserved and accessed over a long time frame.

Some examples of recognised open standards bodies are:

Standards Body	Comments
W3C	World Wide Web Consortium (W3C). Responsible for the development of Web standards. Relevant standards include HTML, XML, CSS, SMIL, SVG, etc.
IETF	Responsible for the development of Internet standards (known as IETF RFCs). Relevant standards include HTTP, MIME, etc.
ISO	International Organisation For Standardization (ISO). Relevant standards areas include character sets, networking, etc.
NISO	National Information Standards Organization (NISO). Relevant standards include Z39.50.
IEEE	Institute of Electrical and Electronics Engineers (IEEE).
ECMA	ECMA International, Association responsible for standardisation of Information and Communication Technology Systems.

Industry Standard: It is often used to refer to a widely used proprietary standard. For example, the proprietary Microsoft Excel format is sometimes referred to as an industry standard for spreadsheets. In a similar way, to provide a consistent format to the user, various softwares conform to a common, relatable standard though some changes can be there in features. This is done so that the user is not confused and does not have to bargain or negotiate between products of different companies and platforms.

Commercial Benefits of Open Standards: The big benefit of Open Source software is not the reduced license costs, but the flexibility it brings.

- Interoperability
- Vendor neutrality
- Efficient use of existing resources
- Greater use of automation
- Flexibility
- More options provide more opportunities to optimise
- Lower and manageable risk
- Robustness and durability
- Quality

11.2.1 FOSS

Free and Open Source Software (FOSS) is a computer software which are free and open source. They are also available and can be freely licenced to use, copy and modify the software based on need or requirement. The source code is openly shared so that user can use or improve the existing software. FOSS provides freedom to run a program for any purpose. You can study the program and can customize it based on your needs. You can use source code freely and can distribute to anyone. We can enhance program and can release the updated code to the public.

Benefits of using FOSS

Secure: Operating System or platform are not perfectly secured but security aspect of FOSS attracted public organizations to consider FOSS solutions.

Stable and Reliable: FOSS servers are functioning fine for years without making any maintenance issues.

Reduced dependence on import of software: FOSS reduces the cost of proprietary software licenses.

Developing Local Software Capability: Everyone is able to modify and redistribute the software which helps in learning and acts as an excellent training system.

Shortcomings of FOSS

There are still few areas where full featured FOSS products are lacking. They are not completely compatible with proprietary systems. But people are switching to FOSS very fast so these type of issues will be reduced. As FOSS mainly focuses on functionality so desired documentation is not available as such.

Some FOSS Projects are:

BIND	DNS Server
Apache	Web Server
Sendmail	Email Server
Open SSH	Secure Network Administration Tool
Open Office	Office Productivity Suite
Linux Kernel	
GIMP	Graphics

In India, department of Electronics and Information Technology (DeitY) has taken many initiatives in adapting the FOSS. India's strength can be increased in the field of Information Technology. This step fill gaps of digital divide with significant cost savings. It increases the knowledge based society and reduces total cost of ownership.

11.2.2 BOSS (Bharat Operating Systems Solutions)

BOSS (Bharat Operating System Solutions) is an Indian GNU/Linux distribution developed by CDAC and is customized to suit Indian's digital environment. It supports most of the Indian languages. BOSS comes with many features required for desktop of government organizations. It helps in routine tasks and utilities for desktop.

BOSS GNU/Linux "main" Component License Policy includes that all applications must have full source code and should allow modification and distribution of modified copies under the same license. BOSS community wants to support software and fix bugs and translate it or improve it, so distribution of source code is very important for them.

BOSS is very user friendly GUI based operating system. As we all are aware that different languages are used and spoken across the country so it provides multilingual support for different states. BOSS is going to prove a revolution in the FOSS development period which has already started in the country.

The BOSS Free & Open Source Software Guidelines

(Ref: BOSS GNU/Linux User Manual from CDAC)

1. Free Redistribution

The license of a BOSS GNU/Linux component may not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license may not require a royalty or other fee for such sale.

2. Source Code

The program must include source code, and must allow distribution in source code as well as compiled form.

3. Derived Works

The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

4. Integrity of The Author's Source Code

The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code.

5. No Discrimination Against Persons or Groups

The license must not discriminate against any person or group of persons.

6. No Discrimination Against Fields of Endeavor

The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

7. Distribution of License

The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

8. License Must Not Be Specific to BOSS GNU/Linux

The rights attached to the program must not depend on the program's being part of a BOSS GNU/Linux system. If the program is extracted from BOSS GNU/Linux and used or distributed without BOSS GNU/Linux but otherwise within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the BOSS system.

9. License Must Not Contaminate Other Software

The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be free softwares.

System Requirements

BOSS GNU/Linux does not impose hardware requirements beyond the requirements of the Linux kernel and the GNU tool-sets. Therefore, any architecture or platform to which the Linux kernel, libc, gcc, etc., have been ported, can run BOSS GNU/Linux. To install BOSS GNU/Linux you need very minimum system configuration.

The hardware requirement details are as follows:

- Hard Disk – 5.0 GB (unpartitioned space)
- RAM – 512 MB
- DVD-ROM drive

To install BOSS GNU/Linux from disc, you need the installation DVD, currently, BOSS GNU/Linux supports the i386 and x86_64 architectures.

11.2.3 Massive Open Online Courses (MOOCs)

Massive Open Online Courses(MOOCs) are also available for learners. It is an online medium for course delivery and learning. Participants can learn various courses of their choice with standard course content or material and assignments (eg: Coursera, edx, khanAcademy etc.).

MOOC is a web-based platform where unlimited number of students get chance of distance education from best institutions in the world. They have forums and interaction sessions between the students, guides and professors. They provide video lectures and course material to students and discuss about problems, issues students are facing. They guide students to get the proper in depth knowledge of the course.

If there are courses of your interest that you are not able to pursue you can do that through MOOC.

How does it work?

MOOC is like an online platform where students and teachers together form a pool of resources which is freely and readily available for you all to utilize.

It facilitates with:

- Listening of lectures.
- Downloading notes.
- Peer evaluation by communicating with each other.
- Virtual online classroom.

MOOCs in India

In India, there are various non-profit and commercial institute. They offer courses worldwide.

Indian Institute of Technology (IITs) and Indian Institute of Science (IISc) offers online courses with no fee and no registration charges, i.e., these courses are free of cost. WizIQ, Open2Study, Coursera, Ed, Udemy are the provider of MOOCs. Coursera is top most provider of MOOCs. NIOS, NCERT, IGNOU, Consortium are for educational qualification, NPTEL, UGC along with the HRD (Human Resource Development) Ministry has also launched the MOOC programs in India for secondary, higher secondary, bachelors and masters degrees. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) offers many courses with audio visual medium, illustrations, research and case study. You can refer swayam.gov.in website for more details.

INTEXT QUESTIONS 11.1

State whether the following statements are true or false:

1. The license of open source requires Fee for sale.
2. W3C is also known as World Wide Web Committee.
3. The distributed program must make the source code accessible to the user in OSI Certification.
4. BOSS is a multilingual software.
5. NPTEL is paid software.

WHAT YOU HAVE LEARNT

- Open source refers to a program in which the source code (i.e., the executable computer program) is generally available to the general public for use or modification from its original design.

- An open standard refers to the standard that allows full public assessment and can be used without constraints in unbiased form.
- Free and Open Source Software (FOSS) is a computer software.
- FOSS can be freely licenced to use, copy and modify the software based on need or requirement. The source code is openly shared so that user can use or improve the existing software.
- BOSS (Bharat Operating System Solutions) is an Indian GNU/Linux distribution developed by CDAC and is customized to suit Indian's digital environment. It supports most of the Indian languages.
- BOSS comes with many features required for desktop of government organizations. It helps in routine tasks and utilities for desktop.
- MOOCs is an online medium for course delivery and learning. Participants can learn various courses of their choice with standard course content or material and assignments.

TERMINAL EXERCISE

1. Define open source software.
2. Write a short note on open standards.
3. What is FOSS? What are the benefits of using FOSS?
4. Describe MOOCs.

ANSWERS TO INTEXT QUESTIONS

11.1

1. False
2. False
3. True
4. True
5. False

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12

INTRODUCTION TO C++

In the previous lesson you have learnt about open source softwares. In this lesson you will learn about C++ programming. You may know that C++ is an extension to C Programming language. It was developed at AT&T Bell Laboratories in the early 1980s by Bjarne Stroustrup. It is a deviation from traditional procedural languages in the sense that it follows Object Oriented Programming (OOP) approach which is quite suitable for managing large and complex programs.

OBJECTIVES

After reading this lesson, you will be able to:

- learn about C++ character set, tokens and basic data types;
- explain the utility of different types of operators used in C++;
- identify the difference between implicit and explicit conversions;
- explain about Input/Output streams supported by C++;
- explain the structure of a C++ program;
- write a simple program in C++.

12.1 C++ CHARACTER SET

Character set is a set of valid characters that a language can recognize. A character represents any letter, digit or any other special character. The C++ programming language also has some character set. Now let us learn C++ language character set.

Table 12.1: C++ character set

Letters	A–Z, a–z
Digits	0–9
Special Characters	Space + - * / ^ \ ( ) [ ] { } = ! = < > . ‘ “ $, ; : % ! & ? _ # <= >= @
White spaces	Horizontal tab (→), Blank space, Carriage return (<) Newline, form feed

12.2 BASIC DATA TYPES

Now you will learn about basic data types used in C++ language. Every program specifies a set of operations to be done on some data in a particular sequence. However, the data can be of many types such as a number, a character, boolean value etc. C++ supports a large number of data types. The built in or basic data types supported by C++ are integer, floating point and character type. A brief discussion on these types is given below:

Table 12.2: Data Types with Range

Data Type	Range
char	–128 to 127
int	–32768 to 32767
short int	–32768 to 32767
long int	–2147483648 to 2147483647
float	-3.4×10^{-38} to 3.4×10^{38}
double	1.7×10^{-308} to 1.7×10^{308}
long double	1.7×10^{-4932} to $1.7 \times 10^{+4932}$

Integer type (int)

An integer is an integral whole number without a decimal point. These numbers are used for counting. For example 26, 373, –1729 are valid integers. Normally an integer can hold numbers from –32768 to 32767. However, if the need be, a long integer (long int) can also be used to hold integers from –2, 147, 483, 648 to 2, 147, 483, 648.

Floating point type (float)

A floating point number has a decimal point. Even if it has an integral value, it must include a decimal point at the end. These numbers are used for measuring quantities.

Examples of valid floating point numbers are: 27.4, -927., 40.03

A float type data can be used to hold numbers from $3.4*10^{-38}$ to $3.4*10^{+38}$ with six or seven digits of precision. However, for more precision a double precision type (double) can be used to hold numbers from $1.7*10^{-308}$ to $1.7*10^{+308}$ with about 15 digits of precision.

Character Type (Char)

It is a non numeric data type consisting of single alphanumeric character. Examples of valid character types are : 'A', '9', 'P', '8', '&'.

It may be noted here that 9 and '9' are of different data types. The former is of type int and later of type char.

12.3 TOKENS

A token is a group of characters that logically belong together. The programmer can write a program by using tokens. C++ uses the following types of tokens.

- Keywords
- Identifiers
- Literals
- Punctuators
- Operators

12.3.1 Keywords

There are some reserved words in C++ which have predefined meaning to complier called keywords. Some commonly used keywords are given below:

List of Keywords

Table 12.3: List of keywords

asm	double	new	switch
auto	else	operator	template
break	enum	private	this
case	extem	protected	try
catch	float	public	typedef
char	for	register	union
class	friend	return	unsigned
const	goto	short	virtual
continue	if	signed	void
default	inline	sizeof	volatile
delete	int	static	while
do	long	struct	

12.3.2 Identifiers

Symbolic names can be used in C++ for various data items used by a programmer in his/her program. For example, if you want to store a value 50 in a memory location, you can choose any symbolic name (say MARKS) and use it as given below:

MARKS = 50

The symbol '=' is an assignment operator. The significance of the above statement is that 'MARKS' is a symbolic name for a memory location where the value 50 is being stored.

A symbolic name is generally known as an identifier. The identifier is a sequence of characters taken from C++ character set. The rules for the formation of an identifier are:

(i) An identifier can consist of alphabets, digits and/or underscores.

(ii) It must not start with a digit.

(iii) C++ is case sensitive, i.e., upper case and lower case letters are considered different from each other. It may be noted that TOTAL and total are two different identifier names.

(iv) It should not be a reserved word (keywords).

12.3.3 Literals

Literals (often referred to as constants) are data items that never change their value during the execution of the program. The following types of literals are available in C++.

(i) integer-constants

(ii) character-constants

(iii) floating-constants

(iv) string-literals

Integer constants

Integer constants are whole numbers without any fractional part. It may contain either + or – sign, but decimal point or commas does not appear in any integer constant. C++ allows three types of integer constants.

1. decimal (Base 10)
2. octal (Base 8)
3. hexadecimal (Base 16)

Decimal integer constants

It consists of sequence of digits and should not begin with 0 (zero). For example 124, - 179, + 108.

Octal integer constants

It consists of sequence of digits starting with 0 (zero). For example, 014, 012.

Hexadecimal integer constant

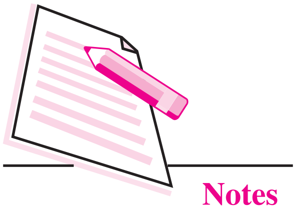
It consists of sequence of digits preceded by ox or OX. For example OXD, OXC. The suffix l or L and u or U attached to any constant forces it to be represented as a long and unsigned respectively.

Character constants

A character constant in C++ must contain one or more characters and must be enclosed in single quotation marks. For example 'A', '9', etc. C++ allows non-graphic characters which cannot be typed directly from keyboard, e.g., backspace, tab, carriage return etc. These characters can be represented by using an escape sequence. An escape sequence represents a single character. The following table gives a listing of common escape sequences.

Table 12.4: List of escape sequence

Escape Sequence	Nongraphic Character
\a	Bell (beep)
\b	Backspace
\f	Formfeed
\n	Newline or line feed
\r	Carriage return
\t	Horizontal tab
\v	Vertical tab
\?	Question mark
\\	Backslash
\'	Single quote
\"	Double quote
\xhh	Hexadecimal number (hh represents the number in hexadecimal
\000	Octal number (00 represents the number in octal
\0	Null



Notes

Floating constants

Floating constants are also called real constants. These numbers have fractional parts. They may be written in fractional form or exponent form. A real constant in fractional form consists of signed or unsigned digits including a decimal point between digits. For example 3.0, -17.0, -0.627 etc.

A real constant in exponent form has two parts: a mantissa and an exponent. The mantissa is either an integer or a real constant followed by letter E or e and the exponent which must be an integer. For example 2E03, 1.23E07.

String Literals

A sequence of character enclosed within double quotes is called a string literal. String literal is by default (automatically) added with a special character '\O' which denotes the end of the string. Therefore the size of the string is increased by one character. For example "COMPUTER" will be represented as "COMPUTER\O" in the memory and its size is 9 characters.

12.3.4 Punctuators

The following characters are used as punctuators in C++.

Brackets [ ]	opening and closing brackets indicate single and multidimensional array subscript.
Parentheses ( )	opening and closing brackets indicate functions calls, function parameters for grouping expressions etc.
Braces { }	opening and closing braces indicate the start and end of a compound statement.
Comma ,	it is used as a separator in a function argument list.
Semicolon ;	it is used as a statement terminator.
Colon :	it indicates a labelled statement or conditional operator
Asterisk *	it is used in pointer declaration or as multiplication operator.
Equal sign =	it is used as an assignment operator.
Pound sign #	it is used as pre-processor directive.

12.3.5 Operators

Operators are special symbols used for specific purposes. C++ includes many operators.

- Arithmetical operators
- Relational operators

- Logical operators
- Unary operators
- Assignment operators
- Conditional operators
- Comma operator

Arithmetical operators

An operator that performs an arithmetic (numeric) operation +, -, *, / , or %. For these operations always two or more than two operands are required. Therefore these operators are called binary operators. The following table shows the arithmetic operators.

Operators	Meaning	Example	Result
+	Addition	8 + 5	13
–	Subtraction	8 – 5	3
×	Multiplication	8 × 5	40
/	Division	8 / 5	1
%	Modulus/Remainder	8 % 5	3

Note : There is no operator which gives exponent in C++.

Modulus operator will return the remainder value after the division. 8 % 5 will return 3 because when you divide 8 by 5, the remainder will be 3.

Relational operators

The relational operators are used to test the relation between two values. All relational operators are binary operators and therefore require two operands. A relational expression returns zero when the relation is false and a non-zero when it is true. The following table shows the relational operators.

Table 12.5: List of relational operators

Relational operators	Meaning
<	Less than
< =	Less than or equal to
= =	Equal to
>	Greater than
> =	Greater than or equal to
! =	Not equal

Notes

Example 1

```
int x = 2;
int l = 1;
int y = 3;
int z = 5;
```

The following statements are true.

(i) l = = 1

(ii) x < y

(iii) z > y

(iv) y > = 1

(v) x ! = 1

(vi) l < = 1

Logical operators

The logical operators are used to combine one or more relational expression. The table 12.6 shows the logical operators.

Table 12.6: List of logical operators

Operators	Meaning
||	OR
&&	AND
!	NOT

The NOT operator is called the unary operator because it requires only one operand.

Example 2

```
int x = 5; int z = 9; int y = 7;
(x > y) & & (z > y)
```

The first expression (x > y) evaluates to false and second expression (z > y) evaluates to true. Therefore, the final expression is false.

In AND operation, if any one of the expression is false, the entire expression is false.

In OR operation, if any one of the expression is true, the entire expression is true.

In NOT operation, only one expression is required.

If the expression is true, the NOT operation of true is false and vice versa.

Unary operators

C++ provides two unary operators for which only one variable is required.

Example 3

```
a = – 50;
a = –b;
a = + 50;
a = + b;
```

Here plus sign (+) and minus sign (-) are unary because they are not used between two variables.

Assignment operator

The assignment operator '=' stores the value of the expression on the right hand side of the equal sign to the operand on the left hand side.

Example 4

```
int m = 5, n = 7;
int x, y, z;
x = y = z = 0;
```

'=' assignment operator. If you write int a = 5 means it will assign value 5 to an integer variable 'a'.

In addition to standard assignment operator shown above, C++ also supports compound assignment operators. C++ provides two special operators viz '++' and '- -' for incrementing and decrementing the value of a variable by 1. The increment/decrement operator can be used with any type of variable but it cannot be used with any constant. With the prefix version of these operators, C++ performs the increment or decrement operation before using the value of the operand. For instance, the following code:

```
int sum, ctr;
sum = 12;
ctr = 4;
sum = sum + (++ctr);
```

will produce the value of sum as 17 because ctr will be first incremented and then added to sum producing value 17.

Similarly, the following code

```
sum = 12;
ctr = 4;
sum = sum + ( – – ctr);
```

will produce the value of sum as 15 because ctr will be first decremented and then added to sum producing value 15.

With the postfix version of these operators, C++ first uses the value of the operand in evaluating the expression before incrementing or decrementing the operand's value. For example, the following code

```
sum = 12;
ctr = 4;
sum = sum + (ctr ++);
```

will produce the value of sum as 16 because ctr will be first used in the expression producing the value of sum as 16 and then increments the value of ctr by 1 (ctr becomes now 5).

Similary, the following code

```
sum = 12;
ctr = 4;
```

sum = sum + (ctr - -) will produce the value of sum as 16 because ctr will be first used with its value 4 producing value of sum as 16 and then decrements the value of ctr by 1 (ctr becomes 3).

Let us study the use of compound assignment operators in the following table:

Table 12.7: Compound assignment operators

Operator	Example	Equivalent to
+ =	A + = 2	A = A + 2
- =	A - = 2	A = A - 2
% =	A % = 2	A = A % 2
/ =	A / = 2	A = A / 2
* =	A * = 2	A = A * 2

Example 5

```
int x = 2; / / first
x + = 5; / / second
```

In the second statement, the value of x is 7.

Conditional operator

The conditional operator ?: is called ternary operator as it requires three operands. The format of the conditional operator is: Conditional_expression? expression1 : expression2;

If the value of conditional_expression is true then the expression1 is evaluated, otherwise expression2 is evaluated.

Example 6

```
int a = 5;
int b = 6;
big = (a > b) ? a : b;
```

The condition evaluates to false, therefore the variable big gets the value from b and it becomes 6.

The comma operator

The comma operator gives left to right evaluation of expressions. It enables to put more than one expression separated by comma on a single line.

Example 7

```
#include <iostream.h>
int main()
{
    int i, j;
    j = 10;
    i = (j++, j+100, 999+j);
    cout << i;
    return 0;
}
```

When the above code is compiled and executed, it produces the following result:

```
1010
```

12.4 THE SIZEOF OPERATOR

As we know that different types of variables, constant, etc., require different amounts of memory to store them. The size of operator can be used to find how many bytes are required for an object to store in memory.

Example 8

```
size of (char) returns 1
size of (int) returns 2
size of (float) returns 4
```

If k is an integer variable, the sizeof (k) returns 2.

Notes

The size of operator determines the amount of memory required for an object at compile time rather than at run time.

12.5 THE ORDER OF PRECEDENCE

The order in which the arithmetic operators (+, -, *, / , %) are used in a given expression is called the order of precedence. The following table 12.7 shows the order of precedence.

Table 12.8: Precedence of Arithmetic operators

Order	Opereators
First	( )
Second	*, /, %
Third	+, –

The expression in the following example is calculated from left or right.

Example 9

(20 + 10)* 15 / 5

= 30 * 15 / 5

= 30 * 3

= 90

The table 12.9 shows the precedence of operators.

Table 12.9: Precedence of Operator

++, – – (post increment/decrement)	Highest ↑
+ + (Pre increment – – (Pre decrement), size of ( ), ! (not), – (unary), + (unary)	
*, /, %	
+ , _	
<, <=, >, >=	
= = , !, =	
&&	
? :	
=	
Comma operator	↓ Lowest

INTEXT QUESTIONS 12.1

1. Fill in the blanks.
   (a) A keyword is a .... word of C++.
   (b) Pascal is a .... language whereas C++ is an .... language
   (c) An identifier must not start with a ....
   (d) .... constants are whole numbers without any fractional part.
   (e) A sequence of characters enclosed within double quotes is called a .... literal.
2. State whether the following statements are true or false:
   (a) An identifier name can start with the underscore '–'.
   (b) A token is a group of characters that logically belong together.
   (c) Literals are data items that generally change their value during program execution.
   (d) An escape sequence represents a single character.
   (e) The symbol # is used as pre-processor directive.
3. List out the various types of tokens used in C++.
4. List out the data types supported by C++.

12.6 TYPE CONVERSION

The process in which one pre-defined type of expression is converted into another type is called conversion. There are two types of conversion in C++.

- Implicit conversion
- Explicit conversion

12.6.1 Implicit conversion

Data type can be mixed in the expression.

Example 10

```
double a;
int b = 5;
float c = 8.5;
a = b * c;
```

When two operands of different types are encountered in the same expression, the lower type variable is converted to the higher type variable. The following table 12.10 shows the order of data types.

Table 12.10: order of data types

Order of data types	
Data type	**order**
long double	(highest)
double	↑
float	↕
long	↕
int	↓
char	lowest

In the example 10, the int value of b is converted to type float and stored in a temporary variable before being multiplied by the float variable c. The result is then converted to double so that it can be assigned to the double variable a.

12.6.2 Explicit conversion

It is also called type casting. It temporarily changes a variable data type from its declared data type to a new one. It may be noted here that type casting can only be done on the right hand side of the assignment statement.

```
int i1 = 10;
int i2 = 4;
float f = (float)i1 / i2;
```

In the above program, we use a float cast to tell the compiler to promote i1 to a floating point value. Because i1 is a floating point value, i2 will then be promoted to a floating point value as well, and the division will be done using floating point division instead of integer division.

12.7 CONSTANTS

A number which does not change its value during execution of a program is known as a **constant**. Any attempt to change the value of a constant will result in an error message. A constant in C++ can be of any of the basic data types.

Const qualifier can be used to declare constant as shown below:

const float Pi = 3.1415;

The above declaration means that Pi is a constant of float types having a value 3.1415.

Examples of valid constant declarations are:

```
const int rate = 50;
const float Pi = 3.1415;
const char ch = 'A';
```

12.8 VARIABLES

A variable is the most fundamental aspect of any computer language. It is a location in the computer memory which can store data and is given a symbolic name for easy reference. The variables can be used to hold different values at different times during the execution of a program.

To understand more clearly let us consider the the following statements:

```
Total = 20.00;          ... (i)
Net = Total - 12.00;    ... (ii)
```

In statement (i), a value 20.00 has been stored in a memory location Total. The variable Total is used in statement (ii) for the calculation of another variable Net. The point worth noting is that the variable Total is used in statement (ii) by its name not by its value.

Before a variable is used in a program, it has to be defined. This activity enables the compiler to make available the appropriate type of location in the memory. The definition of a variable consists of the type name followed by the name of the variable. For example, a variable Total of type float can be declared as shown below:

float Total;

Similarly the variable Net can also be defined as shown below:

float Net;

Examples of valid variable declarations are:

(i) int count;

(ii) int i, j, k;

(iii) char ch, first;

(iv) float total, Net;

(v) long int sal;

12.9 INPUT / OUTPUT (I/O)

C ++ supports input/output statements which can be used to feed new data into the computer or obtain output on an output device such as: VDU, printer etc. It provides both formatted and unformatted stream I/O statements. The following C++ streams can be used for the input/output purpose.

Stream	Description
cin	console input
cout	console output

In addition to the above I/O streams, two operators << and >> are also used. The operator << is known as put to or **bit wise shift operator**. The operator >> is known as **extraction** or **get from operator**.

Let us consider a situation where the user desires to display a message “My first computer” on the screen. This can be achieved through the following statement:

```
cout << “My first computer”;
```

Once the above statement is carried out by the computer, the message “My first computer” will appear on the screen.

Similarly the following program segment defines a variable sum of integer type, initializes it to value 100 and displays the contents of the variable on the screen.

```
.
.
.
int sum;
sum = 100;
cout << “The value of variable sum =”;
cout << sum;
```

Once the above program segment is executed, the following output is displayed on the screen:

The value of variable sum = 100

From the above discussion we see that cout is the standard output stream of C++ by virtue of which output can be displayed on the screen. However the put to operator << is also required to hand over the contents of the variable to cout as shown in Fig. 12.1.

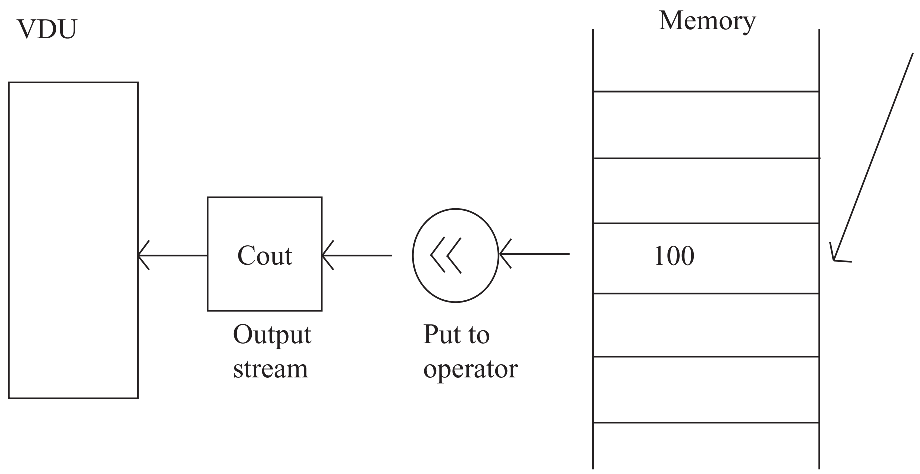


Fig: 12.1: Usage of cout and <<

cin is the standard input stream (keyboard) and it can be used to input a value entered by the user from the keyboard. However, the get from operator >> is also required to get the typed value from cin as shown in Fig. 12.2 and store it in the memory location.

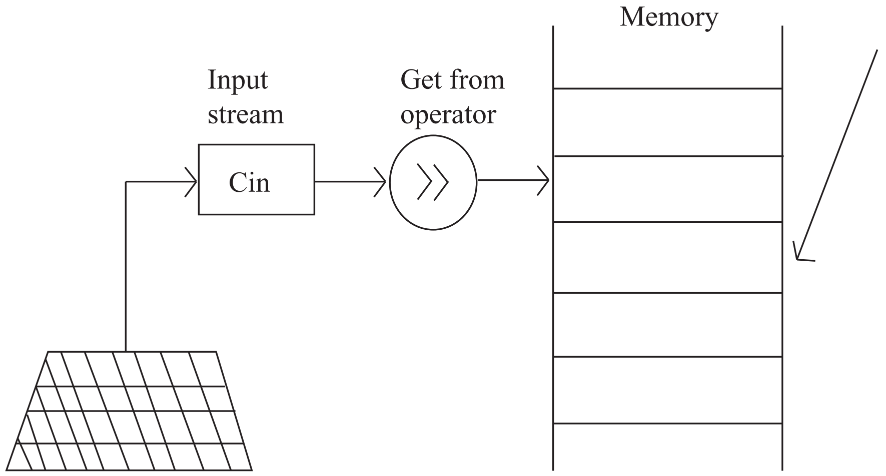


Fig: 12.2: Usage of cin and >>

Let us consider the following program segment:

```
.
.
.
int marks;
cin>> marks;
.
.
.
```

Notes

In the above segment, the user has defined a variable marks of integer type in the first statement and in the second statement user is trying to read a value from the keyboard. Once this set of statements is obeyed by the computer, whatever is typed on the keyboard (say 87) is received by the cin standard input stream. cin then hands over the typed value to get from operator >> which ultimately stores it in memory location called marks. The contents of this variable can be displayed on the screen by the statements given below:

```
cout << “marks=”;

cout << marks;
```

We can use more than one output or put to operators within the same output statement as shown below. The activity is known as **cascading of operators**: cout << “marks =” << marks;   The output of this statement will be

```
cout << “marks=”; << marks;
```

The output of this statement will be marks = 87.

12.10 STRUCTURE OF C++

The structure of a C++ program is given below:

```
# include <header file>

main ( )

{

...............

...............

...............

}
```

A C++ program starts with function called main( ). The body of the function is enclosed between curly braces. The program statements are written within the braces. Each statement must end by a semicolon (statement terminator). A C++ program may contain as many functions as required. However, when the program is loaded in the memory, the control is handed over to function main( ) and it is the first function to be executed.

Let us now write our first program:

```
// This is my first program in C++
/* this program will illustrate different components of a
     simple program in C++*/
# include <iostream.h>
void main ( )
{
cout <<“This is my first program in C++”;
cout  <<  “\n....................................”;
}
```

When the above program is compiled, linked and executed the following output is displayed on the VDU screen.

```
This is my first program in C++
...................................................
```

Various components of this program are discussed below:

(i) Comments

First three lines of the above program are comments and are ignored by the compiler. Comments are included in a program to make it more readable. If a comment is short and can be accommodated in a single line, then it is started with double slash (//)sequence in the first line of the program. However, if there are multiple lines in a comment, it is enclosed between the two symbols /* and */. Everything between /* and */ is ignored by the complier.

(ii) include <iostream.h>

The lines in the above program that start with symbol ‘#’ are called directives and are instructions to the compiler. The word include with ‘#’ tells the compiler to include the file iostream.h into the file of the above program. File iostream.h is a header file needed for input/output requirements of the program. Therefore, this file has been included at the top of the program.

(iii) void main ( )

The word main is a function name. The brackets( ) with main tells that main ( ) is a function. The word void before main( ) indicates that no value is being returned by the function main( ). Every C++ program consists of one or more functions. However, when program is loaded in the memory, the control is handed over to function main( ) and it is the first function to be executed.

(iv) The curly brackets and body of the function main( )

A C ++ program starts with function called main( ). The body of the function is enclosed between curly braces. The program statements are written within the brackets. Each statement must end by a semicolon, without which an error message is generated.

Example 11

Write a C ++ program that reads two values x and y, exchanges their contents and prints the output.

Solution: Let us assume x and y are of type int. We will use a variable temp of type int as a temporary location. Let us write a program.

```
# include <iostream.h>
main ( )
{
int x, y temp;
// ... Read the values x and y
cout << "Enter the values:";
cin >> x >> y;
// ... Exchange the contents
temp = x;
x = y;
y = temp;
// display the output now
cout <<"the exchanged values are:" << x << y; }
```

INTEXT QUESTIONS 12.2

1. Fill in the blanks:

   (a) .... operators are used to test the relation between two values.

   (b) C++ provides two .... operators for which only one variable is required.

   (c) The process in which one pre-defined type of expression is converted into another type is called ....

(d) A .... does not understand the contents of a comment and ignores it.

(e) The operator ++ is known as .... operator.

2. State whether the following statements are true or false:

(a) The computer value of an arithmetic expression is always a numerical value.

(b) '\n' is the remainder operator.

(c) Arithmetic operations on characters is allowed in C++.

(d) The output of logical AND operation is true if one of its operand is true.

(e) + = is a compound assignment operator.

3. Evaluate the following expressions.

(a) 5/3 * 6

(b) 6.0 * 5/3

(c) 6 * 5/3

WHAT YOU HAVE LEARNT

- The built in or basic data types supported by C++ are integer, floating point and character type.
- The identifier is a sequence of characters taken from C++ character set.
- The sizeof operator can be used to find how many bytes are required for an object to store in memory.
- The process in which one pre-defined type of expression is converted into another type is called conversion. There are two types of conversion in C++. i.e., implicit conversion and explicit conversion.
- A number which does not change its value during execution of a program is known as a constant.
- The variables can be used to hold different values at different times during the execution of a program.

TERMINAL EXERCISE

1. What is the difference between a keyword and an identifier?
2. Explain the following terms:

   (i) Literals (ii) Implicit conversion

Notes

3. How many ways are there in C++ to represent an integer constant?
4. State the rules for comment statement.
5. What is an escape sequence? Describe any two backslash character constant?
6. Explain briefly about standard input/output stream of C++.
7. Write the equivalent C++ expression for the following algebraic expression:

   (i) $\dfrac{2AB + 2BC + 2CA}{2A}$

   (ii) $\dfrac{4}{3}x^2$

   (iii) $\dfrac{b^2 - 4ac}{2a}$

8. Evaluate the following C++ expression:

   int a, b = 2, k = 4;

   a = b * 3/4 + k/4 + 8 – b + 5/8;

9. Write an appropriate C++ statement for each of the following:
   (i) Read the values of a, b and c.
   (ii) Write the values of a and b in one line followed by the value of c on another line.
   (iii) Write the values of a and b in one line separated by blanks and value of c after two blank lines.
10. Write a program that will find out the square of a given number.

ANSWERS TO INTEXT QUESTIONS

12.1

1. (a) reserved (b) structured, object-oriented
   (c) digit (d) Integer
   (e) string
2. (a) True (b) True (c) False (d) True (e) True

3. Various types of tokens used in C++ are:

   (i) Keywords (ii) Identifiers

   (iii) Literals (iv) Punctuators

   (v) Operators

4. Data types are:

   (i) Integer type (int)

   (ii) Floating point type (float)

   (iii) Character type (char)

12.2

1. (a) Relational
   (b) Unary
   (c) Conversion
   (d) Compiler
   (e) Increment

2. (a) True (b) False (c) True
   (d) False (e) True

3. (a) 6 (b) 10.0 (c) 10

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13

BASIC CONCEPTS OF OOP

In the previous lesson you have learnt about the basics of C++ programming. Now you will learn about basic concepts of Object Oriented Programming (OOP). The object-oriented programming (OOP) is a different approach to programming and quite suitable for managing large and complex programs. An object oriented language combines the data to its function or code in such a way that access to data is allowed only through its function or code. In this lesson, you will learn about the various benefits provided by OOP and applications of OOP.

OBJECTIVES

After reading this lesson, you will be able to:

- learn the basic concepts used in OOP;
- describe the various benefits provided by OOP;
- explain the programming applications of OOP.

13.1 OBJECT ORIENTED PROGRAMMING

The object-oriented programming is a different approach to programming. It has been created with a view to increase programmer's productivity by overcoming the weaknesses found in procedural programming approach. Over the years many object-oriented programming languages such as C++, Java have come up and are becoming quite popular in the market. The major need for developing such languages was to manage the ever-increasing size and complexity of programs.

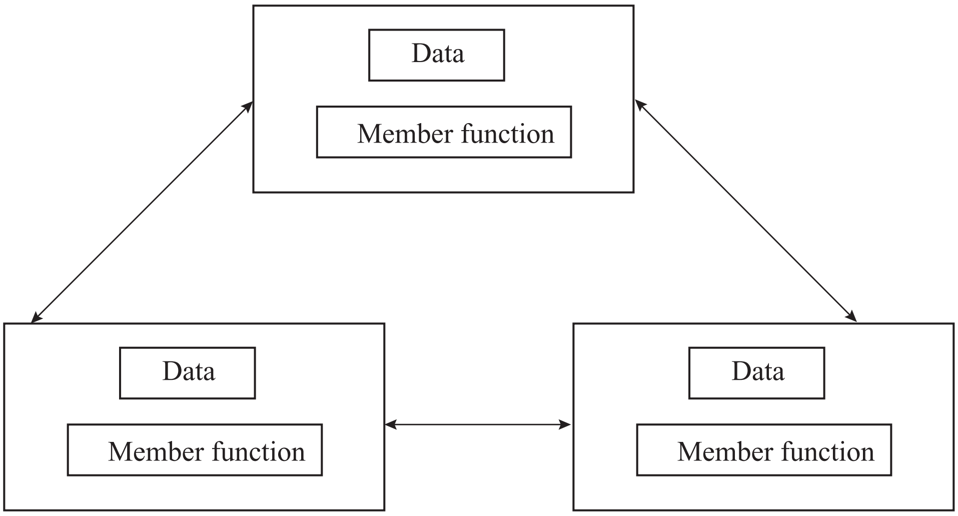

Fig: 13.1: Paradigm of OOP

13.1.1 Features of OOPS

The following are the features of object-oriented programming.

- Objects
- Classes
- Data abstraction
- Data encapsulation
- Inheritance
- Polymorphism

Objects

Object is a class variable or an instance of class. It can represent a person, a bank account or any item that a program can handle. When a program is executed, the objects interact by sending messages to one another.

For example, if 'customer' and 'account' are two objects in a program, then the customer object may send message to account object requesting for a bank balance. Each object contains data and code to manipulate data. Objects can interact without having to know details of each other's data or code. It is sufficient to know the type of message accepted and the type of response returned by the objects.

Class

We have just mentioned that objects contain data and function or code to manipulate that data. The entire set of data and code of an object can be made a user-defined data type with the help of a class. In fact objects are variables of type class. Once a class has been defined, we can create any number of objects associated with that class.

Class Name
Class variables
Class functions

Fig: 13.2: Class Structure

For example, there is a class Employee which has Sue, Bill, Al, Hal, David different employees. Each employee will have unique identity; so they will form the objects of the class Employee.

Class is a user defined data type. It is a blueprint of data and member functions.

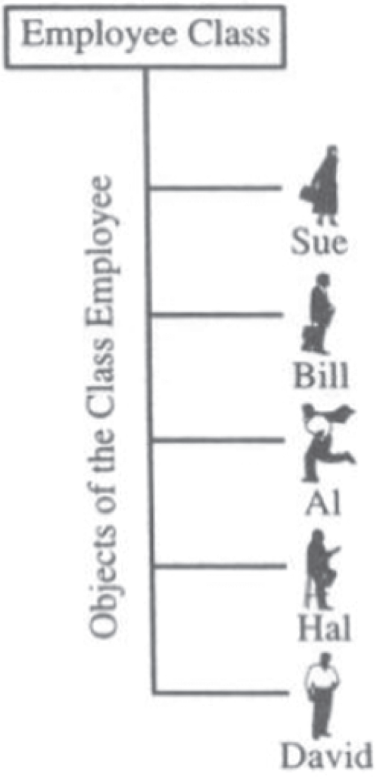

Fig: 13.3: Employee class example

Data Abstraction

Abstraction refers to the act of representing essential features without including the background details. To understand this concept more clearly, take an example of 'switch board'. You only press particular switches as per your requirement. You need not know the internal working of these switches. What is happening inside is hidden from you. This is abstraction, where you only know the essential things to operate on switch board without knowing the background details of switch board.

Data Encapsulation

Wrapping up of data and functions into a single unit is called as data encapsulation. Encapsulation is the most basic concept of OOP. It is the way of combining both data and the functions that operate on that data under a single unit. The only way to access the data is provided by the functions (that are combined along with the data). These functions are considered as member functions in C++. It is not possible to access the data directly. If you want to reach the data item in an object, you call a member function in the object. It will read the data item and return the value to you. The data is hidden, so it is considered as safe and far away from accidental alternation. Data and its functions are said to be encapsulated into a single entity.

In the Figure 13.4 item is a class which has keep_data as member variable which cannot be accessed from outside directly. It can be accessed only via the member functions set() and get_value().

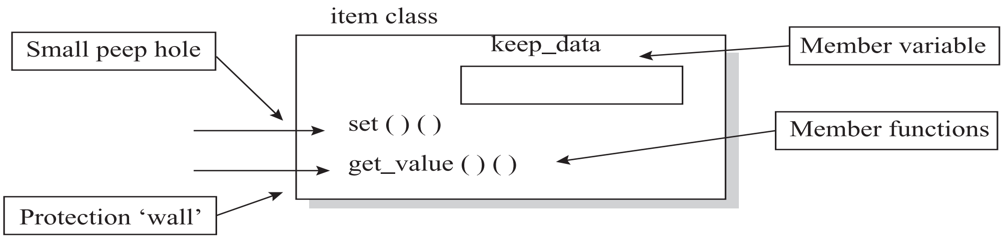

Fig: 13.4: Encapsulated Data and Functions in class item

Modularity

The act of partitioning a program into individual components is called modularity. It gives the following benefits.

- It reduces its complexity to some extent.
- It creates a number of well-defined, documented boundaries within the program.

Module is a separate unit in itself. It can be complied independently though it has links with other modules. Modules work quite closely in order to achieve the program's goal.

Inheritance

It is a process by which object of one class inherit the properties of objects of another class. It is the capability to define a new class in terms of an existing class. An existing class is known as a **base class** and the new class is known as **derived class**. Number of examples can be given on this aspect. For example, a motor cycle is a class in itself. It is also a member of two wheelers class. Two wheelers class in turn is a member of automotive class as shown in Fig. 13.5. The automotive is an example of base class and two wheelers is its derived class. In simple words, we can say a motor cycle is a two wheeler automotive.

C++ supports such hierarchical classification of classes. The main benefit from inheritance is that we can build a generic base class, and obtain a new class by adding some new features to an existing class and so on. Every new class defined in that way consists of features of both the classes. Inheritance allows existing classes to be adapted to new application without the need for modification.

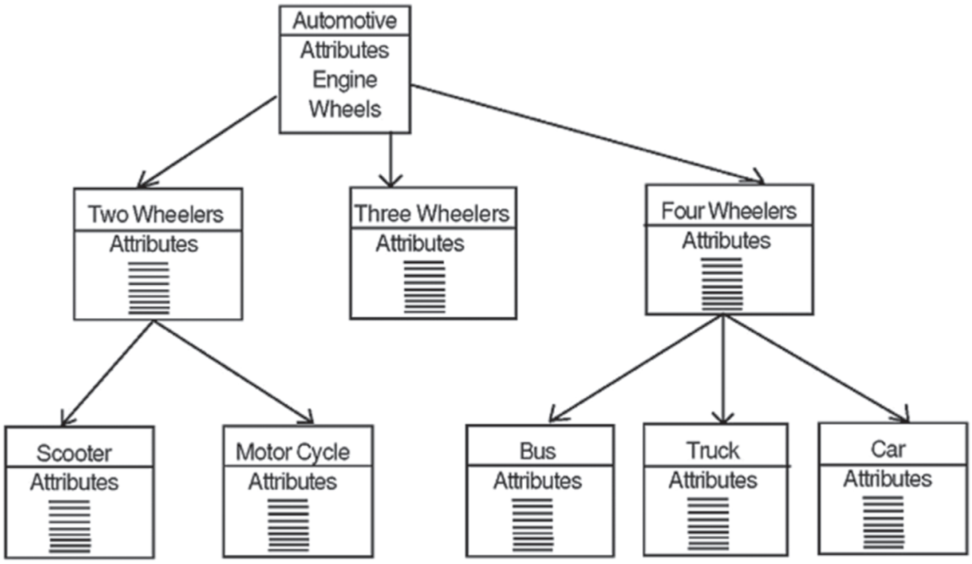

Fig: 13.5: Automotive class

Polymorphism

Polymorphism is a key to the power of OOP. It is the concept that supports the capability of data to be processed in more than one form. For example, an operation may exhibit different behavior in different instances. The behavior depends upon the types of data used in the operation.

For example let us consider Fig 13.6 the operation of addition. For two numbers, the operation will generate a sum. If the operands are strings then the operation would produce a third string by concatenation.

ADD
- Numbers = sum e.g. 1 + 2 = 3
- Strings = concatenated string i.e., a + b = ab

Fig: 13.6: Addition operation

INTEXT QUESTIONS 13.1

1. State whether the following statements are true or false:

   (a) In procedure-oriented programming all data is shared by all functions.

   (b) One of the striking features of OOP is division of program into objects that represent real world entities.

   (c) Wrapping up of data of different types into a single unit is known as encapsulation.

   (d) Object oriented programs are executed much faster than conventional programs.

   (e) Since C is a subset of C++, C programs will run under C++ compilers.

13.2 BENEFITS OF OOP

OOP provides lot of benefits to both the program designer and the user. Object-oriented approach helps in solving many problems related to software development and quality of software product. The new technology assures greater programmer productivity, better quality of software and lesser maintenance cost. The major benefits are:

- Software complexity can be easily managed.
- Object-oriented systems can be easily upgraded.
- It is quite easy to partition the work in a project based on objects.
- Objects created for object oriented program can easily be reused in other programs.

Programming Applications of OOP

OOP has become one of the programming buzzwords today. There appears to be a great deal of excitement and interest among software programmers in using OOP. Applications of OOP are gaining importance in many areas. OOP has been extensively used in the development of Windows and word based systems such as MS-Windows, x-Windows etc. The promising application areas of OOP are:

(i) **Multiple uses of data structure:** This is an application where the same data structure is used many times. For example a window data structure is used multiple-times in a windowing system.

(ii) **Data in multiple programs:** This is an application where the same operations are performed on a data structure in different programs. For example, record validation in an accounting system.

The other application areas of OOP are parallel programming, simulation and modeling, AI and Expert systems, Neural Networks and CAD systems, object-oriented databases.

INTEXT QUESTIONS 13.2

1. Fill in the blanks.
   (a) C++ is an .... language.
   (b) An .... is a self contained unit of .... and function.
   (c) A .... can be used to create objects of its own type.
   (d) .... is a way of combining data with functions into an object.
   (e) A derived class can be derived from a .... class.
2. State whether the following statements are true or false:
   (a) C++ is an extension to C programming language.
   (b) Functions of one object cannot access the functions of other objects in C++
   (c) Inheritance is the capability to define a new class in terms of an existing class.
   (d) Abstraction refers to the act of representing essential features without including the background details.
   (e) An object is a new data type.

WHAT YOU HAVE LEARNT

- Object is a class variable or an instance of a class.
- Abstraction refers to the act of representing essential features without including the background details.
- Data encapsulation is the way of combining both data and the functions that operate on that data under a single unit.

- Inheritance is a process by which object of one class inherit, the properties of objects of another class.
- Polymorphism means multiple forms of same thing.

TERMINAL EXERCISE

1. What are the features of OOP?
2. Explain the following terms briefly:
   (a) Data abstraction
   (b) Data encapsulation
   (c) Polymorphism
   (d) Inheritance
3. Describe the various benefits of OOP.

Notes

ANSWERS TO INTEXT QUESTIONS

13.1

1.	(a) False	(b) True	(c) False
	(d) False	(e) True	

13.2

1.	(a) OOP	(b) Object, data	(c) class
	(d) encapsulation	(e) base	
2.	(a) True	(b) False	(c) True
	(d) True	(e) False	

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14

CONTROL STATEMENTS

In the previous lesson you have learnt about general concepts of OOP. Now you will learn about control statements which help you to control movements of data and also help you to make decisions based on the conditions. The normal flow of execution in a high level language is sequential, i.e., each statement is executed in the order of its appearance in the program. However, depending on the requirements of a problem it might be required to alter the normal sequence of execution in a program. The statements which specify the order of execution of statements are called control flow statements. There are many control flow statements provided in C++ that will be discussed in this lesson.

OBJECTIVES

After reading this lesson, you will be able to:

- differentiate between a statement and compound statement;
- learn about the conditional statements and their use;
- familiarize with the loop statement;
- differentiate between while and do-while loop;
- identify jump statements;
- explain how to exit from the program.

14.1 STATEMENTS

Statements are the instructions given to the computer to perform any kind of action. Action may be in the form of data movement, decision making etc. Statements form the smallest executable unit within a C++ program, which are always terminated by semicolon.

14.1.1 Compound Statement

A compound statement is a grouping of statements in which each individual statement ends with a semi-colon. The group of statements are called block. Compound statements are enclosed between the pair of curly braces "{ }". The opening curly brace "{" signifies the beginning and closing curly brace "}" signifies the end of the block.

Notes

14.1.2 Null Statement

Writing only a semicolon indicates a null statement. Thus ';' is a null or empty statement. This is quite useful when the syntax of the language needs to specify a statement but the logic of the program does not need any statement. This statement is generally used in for and while looping statements.

14.1.3 Conditional Statements

Sometimes the program needs to be executed depending upon a particular condition. C++ provides the following statements for implementing the selection control structure.

(i) 'if ' statement

(ii) 'if else' statement

(iii) 'if-else if.. else

(iv) 'nested if' statement

(v) 'switch' statement

(i) 'if' statement

syntax of the 'if' statement

```
if (condition)
{ statement(s);
}
```

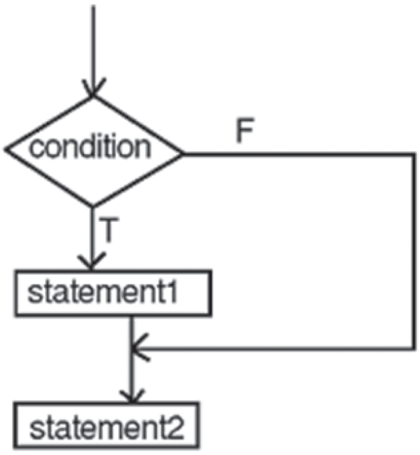


Fig. 14.1: if statement

From the Fig 14.1 it is clear that if the 'if condition' is true, statement 1 is executed, otherwise it is skipped and directly statement 2 will be executed. The statement 1 may either be a single or compound statement.

Notes

(ii) 'if else' statement

syntax of the if- else statement

```
if (condition)
{
statement1;
}
else
{
statement 2;
}
statement 3;
```

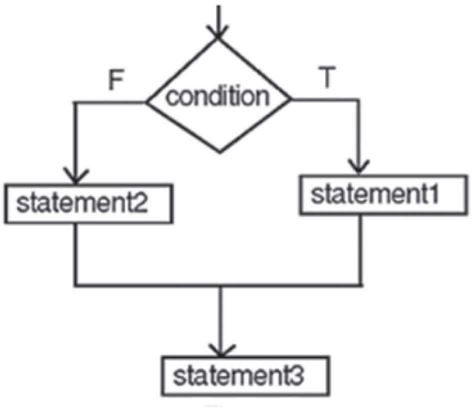


Fig. 14.2: if – else statement

From the Fig 14.2, it is clear that the given condition is evaluated first. If the condition is true, statement1 is executed, followed by statement 3. If the condition is false, statement2 is executed, followed by statement 3. It should be kept in mind that statement1 and statement2 can be single or compound statement.

Example 1

Write a program that will print the greatest of two numbers.

```
# include <iostream.h>
void main( )
{
int x, y;
cout << "Enter two numbers" <<"\n";
cin>> x >> y ;
if ( x > y)                                  // if condition
cout << "The bigger number is " << x;       // if true this statement will execute
else                                         // if false this statement will execute
cout << "The bigger number is" <<y;
}
```

The output of the above program is:

```
Enter two numbers
10
15
The bigger number is 15
```

Notes

Example 2

Write a program that will print the greatest of three numbers (use multiple if – else)

```
# include <iostream.h>
void main ( )
{
int x, y, z, l;
cout << "Enter three numbers" <<"\n";
cin >> x >> y >> z;
if (x > y )                                   // 1st if condition
l = x ;
else                                          // 1st else condition
l = y ;
if (l > z)                                    //2nd if condition
cout << "The greatest number is" << l;
else
cout << "The greatest number is" <<z;         //2nd else condition
}
```

The output of the above program is

```
Enter three numbers
10
15
20
The greatest number is 20
```

iii) 'Nested if' statement

Syntax of the nested if statement

The if or else if statement can be used inside another if or else if statement(s).

```
    if (condition1)
    {
    if (condition2)
    {
    statement(s);
    }
    }
```

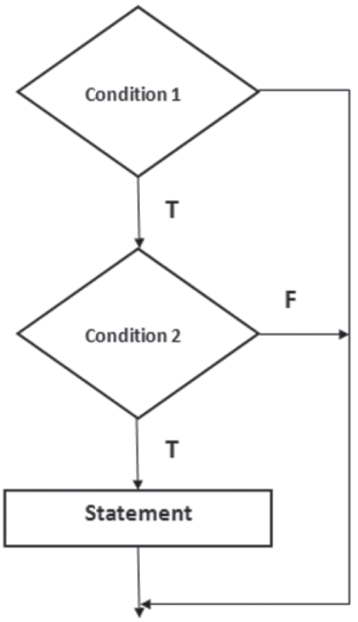


Fig. 14.3: Nested if Statement

(iv) if – else if – else

Syntax of if else if else

if (condition 1)

statement1;

else if (condition 2)

statement2;

else statement 3;

In a program, the statement x = 5; assigns the value 5 to the variable x. If you write a statement if (x = = 5) - here it checks whether the value of x is equal to 5 or not.

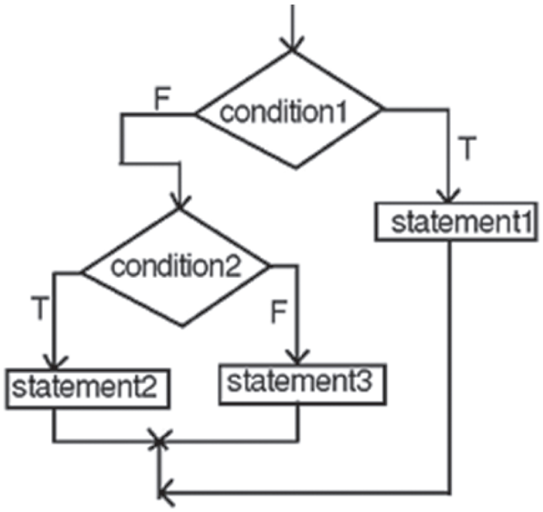


Fig. 14.4: if else if else statement

If condition1 is TRUE, then statement1 is executed. Else condition 2 is checked, if condition 2 is true then statement 2 is executed. If both the condition fails then statement 3 will be executed. For any given condition only one of the statements (Statement1, Statement2, or Statement3) will be executed. Regardless of which statement is executed, control is passed to the statement following statement3. Each statement can be single or compound statement.

Example 3

Write a program that will find the greatest of three numbers (use nested if - else).

```
# include < iostream.h>
void main ( )
{
int x, y, z;
cout << "Enter three numbers" << "\n";
cin >> x >> y >> z ;
if ( x > y )                                    //1st if
     {
     if (x >z)                                  //2nd if nested in 1st else
     {cout << "The greatest number is" << x; }
     else                                       //2nd else
     cout << "The greatest number is" <<z;
     }
else                                            //1st else
     {
     if (y > z)                                 // 3rd if nested in else
     {cout << "The greatest number is" << y; }
     else                                       // 3rd else
     {cout "The greatest number is" << z; }
     }
}
```

Example 4

Write a program using nested if condition that will enter total marks and assign grades according to the following:

Mark	Grade
> = 90	A
> = 80 and < 90	B
> = 70 and < 80	C
> = 60 and < 70	D
< 60	Fail

```
# include <iostream.h>
void main ( )
{
int marks;
cout << "Enter total marks" << "\n";
cin >> marks;
if (marks > = 90)                    //1st if
cout << "A Grade";
else                                 // 1st else
if (marks > = 80)                    //2nd if nested in 1st else
cout << "B Grade";
else                                 //2nd else
if (marks > = 70)                    //3rd if nested in 2nd else
cout << "C Grade";
else                                 // 3rd else
if (marks > = 60)                    //4th if nested in 3rd else
cout << "D Grade";
else                                 //4th else
cout << "Fail";
}
```

v. switch statement

The if and if-else statements permit two way branching whereas switch statement permits multiple branching.

The syntax of switch statement is:

```
switch (var / expression)
{
case constant1 :        statement1;
                        |
                        |
                        |
                        break;
case constant2 :        statement2;
                        |
                        |
                        |
                        break;
default :               statement3;
}
```

The execution of switch statement begins with the evaluation of expression. If the value of the expression matches with the constant then the statements following the expression will be executed sequentially till the break statement. The break statement transfers control to the end of the switch statement. If the value of expression does not match with any constant, the statement with default will be executed.

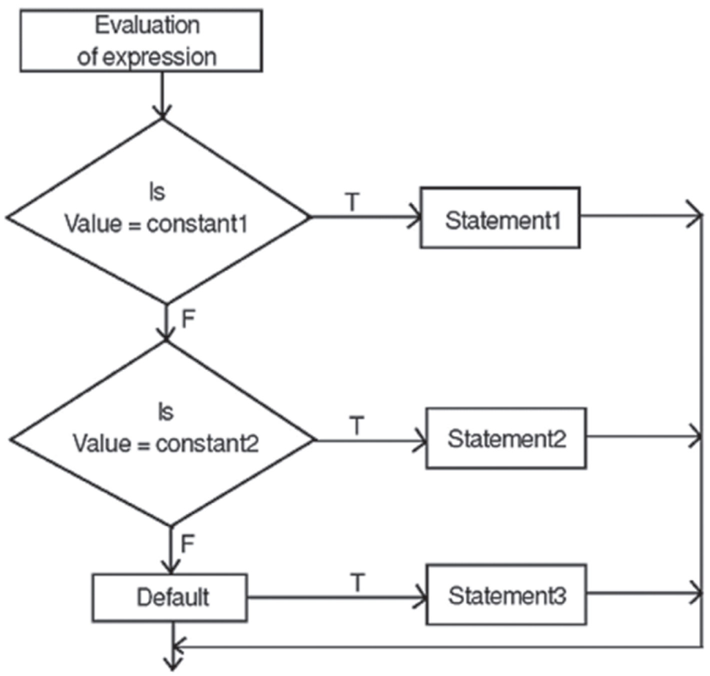


Fig. 14.5: Switch statement

Example 5

Write a program to show the use of switch statement

```
# include < iostream.h>
void main ( )
{
char ch;
cout << “Enter a character”;
cin >> ch;
switch (ch)                                   //switch statement
{
case ‘a’   :   cout << “vowel a”;
               break ;
case ‘e’   :   cout << “vowel e”;
               break ;
case ‘o’   :   cout << “vowel o”;
               break ;
case ‘i’   :   cout << “vowel i”;
               break ;
case ‘u’   :   cout << “vowel u”;
               break;
default    :   cout <<“not a vowel”;
}
}
```

The program needs the break statement to confine execution to a particular portion of switch. If the break statement is removed from the above program then it starts executing the statements associated with case labels specified till it comes across either the break statement or end of switch statement. The above switch statement can be written as:

```
switch (ch)
{
case ‘a’   :
case ‘A’   :   cout << “vowel a”;
break;
case ‘e’   :
case ‘E’   :   cout << “vowel e”;
break;
```

```
    case 'i':
    case 'I'   :   cout << "vowel i";
                   break;
    case 'o'   :
    case 'O'   :   cout << "vowel o";
                   break;
    default    :   cout << "not a vowel";
    }
```

The input character either in small letter or capital will be accepted.

Example 6

Write a program that will accept a one character grade code and depending on the grade code display the basic salary according to the table given below:

Grade	Basic salary
A	15000
B	12000
C	10000
D	9000

```
# include <iostream.h>
void main ( )
{
char grade;
cout << "Enter Grade" << "\n";
cin >> grade;
switch (grade)                                  // switch statement
     {
     case 'A'   :   cout << "Basic salary is 15000";
                    break;
     case 'B'   :   cout << "Basic salary is 12000";
                    break;
     case 'C'   :   cout << "Basic salary is 10000";
                    break;
     case 'D'   :   cout << "Basic salary is 9000";
                    break;
     default    :   cout << "Invalid grade code";
     }
}
```

Notes

INTEXT QUESTIONS 14.1

1 Identify the error(s), if any, in the following programs and write them in correct format.

a)
```
# include <iostream.h>
void main ( )
int a, b;
cin << b; <<a;
if (a > b) max = a
}
```

b)
```
# include <iostream.h>
void main( )
{
int x, y;
cin >> x ;
for (y = 0 ; y < 10, y ++)
if x = = y
cout << y + x ;
else
cout >> y;
}
```

2. What will be the output of the following program segment?

a)
```
cin >> x;
if ( x = = 10 )
cout << "x is 10" ;
else
cout <<  "x is not 10" ;
```

if the input given is

(i) 11

(ii) 10

b)
```
int year ;
cin >> year ;
if (year % 100 = = 0)
if (year % 400 = = 0)
{
cout << "Leap" ;
else
cout << "Not century year" ;
}
```
if the input is

(i) 2000

(ii) 1971

c)
```
int year ;
cin >> year ;
if (year % 100 = = 0)
{
if (year % 400 = = 0)
cout << "Leap" ;
}
else
cout << "Not century year" ;
```
if the input given is

(i) 2000

(ii) 1971

3. What would be the value of c?
```
{
int c;
float a, b;
a = 245.05;
b = 40.02 ;
c = a + b;
}
```
a) 285.09 b) 2850 c) 285 d) 285.0

Notes

4 What would be the value of i and k?

```
{
int i, j, k ;
j = 5 ; i = 2 * j / 2 ;
k = 2 * (j/2) ;
}
```

a) i = 4, k = 4 b) i = 4, k = 5 c) i = 5, k = 4 d) i = 5, k = 5

5. What is the output of the following program?

```
void main ( )
{
int x = 5, y = 6, z = 7;
if (x < y + z)
cout << "Hello \n" ;
else
{
cout << "How \n" ;
cout << "Are you \n";
}
}
```

a) Hello b) How c) Are you d) None of the above

6. Consider the program segment.

```
switch (choice)
{
case 'W'   :   cout << "WHITE" ;
case 'R'   :   cout << "RED" ;
case 'B'   :   cout << "BLUE" ;
default    :   cout << "error" ;
               break ;
}
```

What would be the output if choice = 'R'?

a) RED b) RED BLUE error

c) RED error d) WHITE RED BLUE

Notes

14.2 LOOP CONSTRUCT

It is also called a repetitive / iterative control structure. Sometimes we require a set of statements to be executed a number of times by changing the value of one or more variables each time to obtain a different result. This type of program execution is called **looping**. C++ provides the following constructs.

(i) while loop

(ii) do - while loop

(iii) for loop

(i) while loop

Syntax of while loop

```
while (condition)
{
statement(s);
}
```

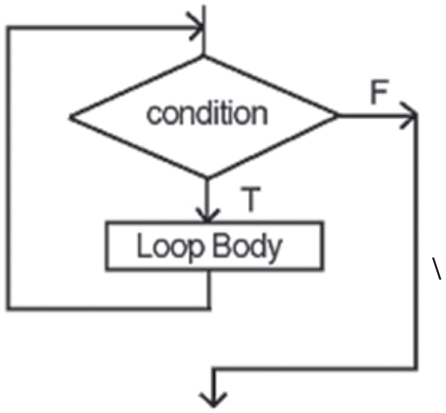


Fig. 14.6: while loop

The Fig 14.6 indicates that a condition is first evaluated. If the condition is true, then the loop body will be executed and the condition will be re-evaluated. Hence, the loop body is executed repeatedly as long as the condition remains true. As soon as the condition becomes false, it comes out of the loop and goes to the statement next to the 'while' loop.

Example 7

Write a program to find the sum of first ten natural numbers i.e. 1, 2, 3, ...10.

```
# include <iostream.h>
void main( )
{ int n, total = 0 ;
n = 1 ;
while (n < = 10)                                    // while condition
{
total + = n ;
n + + ;
}
 cout << "sum of first ten natural number is" << total :
}
```

The variable n is called a loop control variable since its value is used to control loop repetition. Normally, the three operations listed below must be performed on the loop control variable.

(i) Initialize the loop control variable

(ii) Test the loop control variable

(iii) Update the loop control variable

Operation (i) must be performed before the loop is entered. Operation (ii) must be performed before each execution of the loop body, depending on the result of this test, the loop will either be repeated or make an exit. Operation (iii) must be included as part of the loop body. Unless the loop control variable is updated in the loop body, its value will not change and loop exit will never occur.

(ii) do-while loop

Syntax of do-while loop

```
do {
} while (condition);
```

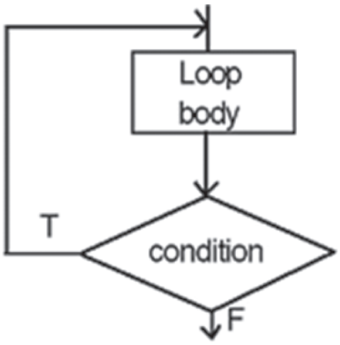


Fig. 14.7: do – while loop

The Fig 14.7 indicates that after each execution of the loop body, the condition will be checked. If the condition is true, then the loop body will be executed again. If the condition evaluates to false, loop exit occurs and the next program statement is executed.

Note : The loop body is always executed at least once in the do-while loop.

One important difference between while loop and do-while loop is the relative ordering of the conditional test and loop body execution. In the while loop, the loop repetition test is performed before each execution of the loop body; the loop body is not executed at all if the initial test fails. In the do-while loop, the loop termination test is performed after each execution of the loop body; hence, the loop body is always executed at least once.

Example 8

Write a program to find the sum of the first N natural number.

```
# include < iostream.h>
void main( )
{
int N, number, sum;
cin >> N;
sum = 0;
number = 1;
do
{
sum + = number;
number + + ;
} while (number < = N) ;
cout << sum;
}
```

(iii) For loop

It is a count controlled loop in the sense that the program knows in advance how many times the loop has to be executed. Repeats a **statement** or group of statements while a given condition is true.

syntax of for loop

for (intialization; decision; increment/decrement)
{ statement(s);
}

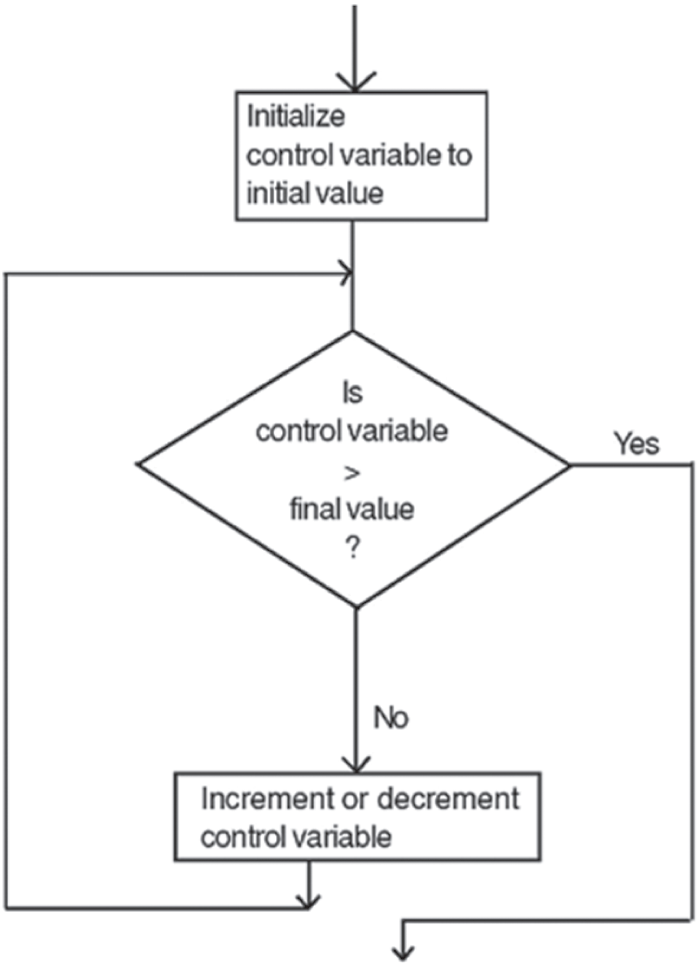


Fig. 14.8: for loop

The Fig 14.8 indicates that in for loop three operations take place:

(i) Initialization of loop control variable

(ii) Testing of loop control variable

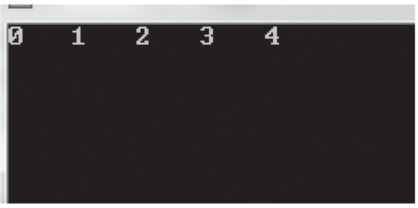
(iii) Update the loop control variable either by incrementing or decrementing.

Operation (i) is used to initialize the value. On the other hand, operation (ii) is used to test whether the condition is true or false. If the condition is true, the program executes the body of the loop and then the value of loop control variable is updated. Again it checks the condition and so on. If the condition is false, it gets out of the loop.

Use of "for" Statement

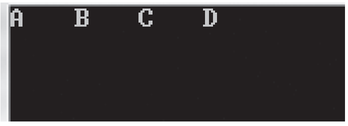
```
for (int i = 0 ; i < 5 ; i + + )
cout << i ;
```

The output of the above program is




```
for (char i = 'A'; i < 'E' ; i + + )
cout < < i ;
```

The output of the above program is



INTEXT QUESTIONS 14.2

1. How many times will the following loop be executed ?

   a)
   ```
   int s = 0, i = 0;
   while ( i + + < 5)
   s + = i;
   ```

   b)
   ```
   int s = 0 ; i = 0;
   do
   s + = i ;
   while ( i < 5 ) ;
   ```

2. What will be the output of the following program ?

a)
```
# include <iostream.h>
void main ( )
{
long number = 7866372, result = 0 ;
do
{ result * = 10 ;
int digit = number % 10 ;
result + = digit ;
number / = 10 ;
}
while (number) ;
cout << "output =" << result << endl;
}
```

b)
```
void main ( )
{
int i = 0, a = 0, b = 0, c = 0, f = 0 ;
while ( i < = 5)
{
switch (i + +)
{
case 1 :
case 2 : + + a ;      break;
case 3 :
case 4 : + + b ;      break;
case 5 : + + c ;      break;
default : + + f ;     break;
}
}
cout << a << "\n" ;
cout << b << "\n" ;
cout << c << "\n" ;
cout << f << "\n" ; }
```

3. What will be the value of counter after the following program is executed?

```
void main ( )
{
int counter ;
int digit = 0 ;
counter = 1 ;
  while (digit < = 10)
  {
  + + counter ;
  + + digit ;
  }
  cout <<counter ;
  }
```

a) 9 b) 10 c) 11 d) 12

4. What will be the value of sum after the following program is executed ?

```
void main ( )
{
int sum, i ;
sum = 1 ;
i = 9 ;
do {
i = i - 1 ;
sum = 2 * sum ;
}
while (i > 9) ;
cout << sum ;
}
```

a) 1 b) 2 c) 9 d) 0.5

5. What will the following program do ?

```
void main ( )
{
int digit = 0 ;
do
{
cout << digit + + << "\n" ;
}
while (digit < = 10);
}
```

Notes

a) Display integers from 1 to 10
b) Display integers from 0 to 10
c) Adding 10 integers
d) None of the above

6. What is the final value of digit variable?

```
void main ( )
{
int digit ;
for (digit = 0 ; digit < = 9 ; digit + + )
cout << digit << "\n" ;
digit = 5 * digit ;
– – digit ;
}
```

a) 49 b) –1 c) 47 d) 46

14.3 JUMP STATEMENTS

The jump statements unconditionally transfer program control to another statement elsewhere in program code. You can use the following statements in a program to (Jump statements) to transfer program control from one statement to another statement.

a) goto statement
b) break statement
c) continue statement

(a) goto statement

Goto statement can be used in the program where you want to transfer your program control to another statement of the program. Let us see an example here.

syntax of goto statement

```
goto pgr;
|
|
|
pgr :
```

When program control reaches the statement goto pgr, it will transfer the control to the statement after label pgr. Now the program will start to exceute the statements mentioned after pgr:

pgr is known as label. It is a user defined identifier. After the execution of goto statement, the control transfers to the line after label pgr.

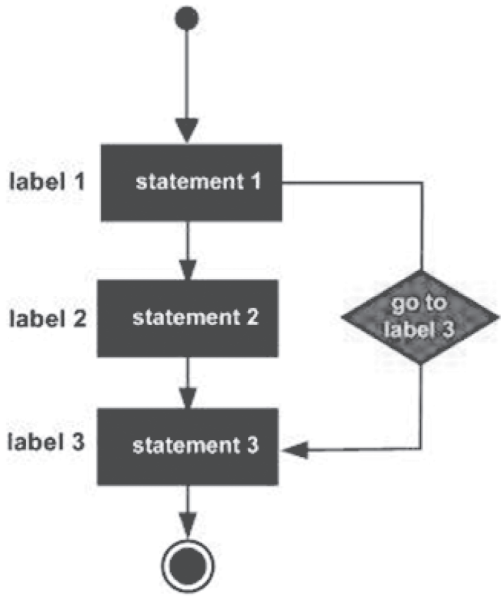


Fig. 14.9: goto statement

Note : It is not a good programming skill to use goto statement in a program.

Example 9

```
#include <iostream.h>
int main( )
{
    int num = 1;
    STEP:do
    {
        if( num == 5)
    {
        num = num + 1;
        goto STEP;
    }
    cout << "value of num : " << num << endl;
    num = num + 1;
    }while( num < 10 );
    return 0;
}
```

Notes

(b) Break statement

The break statement can be used in a switch statement and in any of the loops. It causes program execution to pass to the next statement following the switch or the loop.

Syntax of break statement.

```
while (condition)
{
statement 1;
if (condition)
break;
statement 2;
}
statement 3;
```

The difference between the break and continue statement is that break statement comes out of the loop and executes the next statement after the loop. Contine statement skips rest of the loop and starts new iteration of the same loop.

The break statement skips rest of the loop and goes out of the loop.

(c) Continue statement

The continue statement is used in loops and causes a program to skip the rest of the body of the loop.

```
while (condition)
{
statement 1;
if (condition)
continue;
statement 2;
}
statement 3;
```

The continue statement skips rest of the loop body and starts a new iteration.

14.4 EXIT FUNCTION

The execution of a program can be stopped at any point with exit ( ) and a status code can be informed to the calling program. The general format is

exit (code);

where code is an integer value. The code has a value 0 for correct execution. The value of the code varies depending upon the operating system. It requires a process.h header file.

INTEXT QUESTIONS 14.3

1. The goto statement causes control to go to ....

   (i) an operation

   (ii) a label

   (iii) a variable

   (iv) a function

2. The break statement causes an exit ....

   (i) only from the innermost loop

   (ii) only from the innermost switch

   (iii) from all loops and switches

   (iv) from the innermost loop or switch

3. A continue statement within a loop causes control to go to ....

4. Name the header file to be included in the program for using the exit ( ) function.

5. What will be the output of following program ?

```
# include < iostream.h>
void main ( )
{
int x = 10, count = 0 ;
while (x)
```

```
{
x – – ;
if (x = = 4)
continue ;
count + + ;
}
cout << "\n" <<count ;
}
```

6 What will be the output of the above program ?

```
# include < iostream.h>
# include < stdio.h>
void main ( )
{
char ch = 'A' ;
while (ch < = 'F' )
{
switch (ch)
{
case 'A' :
case 'B' :
case 'C' :
case 'D' : ch + + ; continue ;
case 'E' :
case 'F' : ch + + ; }
putchar (ch) ;
}
}
```

a) ABCDEF b) FG c) EFG d) None of the above

WHAT YOU HAVE LEARNT

- Statements are the instructions given to the computer to perform any kind of action.
- Compound statement is a grouping of statements in which each individual statement ends with a semicolon.
- Sometimes we require a set of statements to be executed a number of times by changing the value of one or more variables each time to obtain a different result. This type of program execution is called looping.
- In the while loop, the loop repetition test is performed before each execution of the loop body; the loop body is not executed at all if the initial test fails.
- In the do-while loop, the loop termination test is performed after each execution of the loop body. Hence the loop body is always executed at least once.
- Continue statement is used in loops and causes a program to skip the rest of the body of the loop.
- The execution of the program can be stopped at any point with exit() statement.

TERMINAL EXERCISE

1. Write a program to display the following menu and accept a choice number. If an invalid choice is entered, then appropriate error message must be displayed. Otherwise the choice number entered must be displayed.

   MENU

   1. Create a data file
   2. Display a data file
   3. Edit a data file
   4. Exit

   Choice :

2. Write a program that will accept a mark and assign letter grade according to the following table.

Grade	Mark
A	> = 90
B	> = 80 but < 90
C	> = 70 but < 80
D	> = 60 but < 70
F	< 60

3. Write a program that will print sum of N integers entered by the user.

4. Write a program to generate the members of fibonacci series upto 500.

5. Write a program to reverse a given number.

6. Write a program that will print the table of any number upto any number.

   input :
   Enter the table of which number : 4
   Enter upto which number : 5
   Output
   $4 \times 1 = 4$
   $4 \times 2 = 8$
   $4 \times 3 = 12$
   $4 \times 4 = 16$
   $4 \times 5 = 20$
   Continue (Y/N) ?

7. Write a program that will print the factorial of any number.

8. Write a program to print all the tables between 2 and 20 upto 10.

9. Write a program that will find pythagorean triplets between 1 to 100. (Pythagorean triplets are such that the square of one number is equal to the sum of the squares of the other two numbers).

   Example : 3, 4, 5
   $5^2 = 3^2 + 4^2$
   $25 = 9 + 16 = 25$

10. Write a program to find out the sum of the series $1 + x + x^2 + x^2$ .... x^n

11. Write a program that will take a number N as input and print the factorial of all numbers from 1 to N as follows :

<table>
<tr><th>Number</th><th>Factorial</th></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>2</td><td>2</td></tr>
<tr><td>3</td><td>6</td></tr>
<tr><td>|</td><td>|</td></tr>
<tr><td>|</td><td>|</td></tr>
<tr><td>|</td><td>|</td></tr>
<tr><td>N</td><td>N!</td></tr>
</table>

12. Write a program that will find out whether the given number is even or odd. If odd number then find out whether it is prime or not.

13. Write a program that will ask the user to enter N integers. Find out the following:

    (i) Total number of positive integers

    (ii) Total number of negative integers

    (iii) Total number of integers equal zero

ANSWERS TO INTEXT QUESTIONS

14.1

1 a)
```
# include <iostream.h>
void main( )
{
int a, b, max;
cin >> b >>a;
if (a > b) max = a;
}
```

b)
```
# include <iostream.h>
void main ( )
{
int x, y;
cin >> x;
for (y = 0; y < 10 ; y++)
if (x = = y)
```

Notes

```
cout << y + x;
else
cout << y;
}
```

2. a) (i) x is not 10
   (ii) x is 10
   b) (i) Leap
   (ii) No output
   c) (i) Leap
   (ii) Not century year
3. c) 285
4. c) i = 5, k = 4
5. Hello
6. b) RED error

14.2

1. a) 5 times b) endless
2. a) output = 2 7 3 6 6 8 7 b) 2 2 1 1
3. d) 12
4. b) 2
5. b) Display integers from 0 to 10
6. a) 49

14.3

1. (ii) a label
2. (iv) from the innermost loop or switch
3. the decision statement of loop
4. process.h
5. 9
6. (b) FG

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15

FUNCTIONS

In the previous lesson you have learnt about control statements of C++ programming language. In this lesson you will learn about functions in C++. A function is a group of statements that together perform a task. Every program in C++ has main() function by default. C++ standard library provides lot of built-in functions that you can call or use in your program.

OBJECTIVES

After reading this lesson, you will be able to:

- define function;
- use # include directive;
- list library functions;
- call functions;
- define inline function.

15.1 FUNCTION

Functions are blocks of code that perform a task to accomplish something productive. When you want to group same statements depending upon their actions like finding total, average, etc., you can put them in a function. Whenever you need these set of statements you can call this function in your program. A function may be user defined function or library function. C++ provides a lot of built in functions which you will learn in the next section. To use library functions in a C++ program you have to include header files.

A header file may be included in one of the two ways. # include <iostream.h> or # include "iostream.h". The header file in angle brackets <and> means that file reside in standard include directory. The header file in double quotes means that file resides in current directory. The # include directive instructs the compiler

Notes

to read and include another file in the current file. The compiler compiles the entire code.

15.2 LIBRARY FUNCTIONS

You know that C ++ provides many built in functions that save programming time and effort required.

Mathematical Functions

Mathematical functions like sin ( ), cos ( ), etc., are defined in header file math.h. Some of the important mathematical functions are given in the following table.

Some standard mathematical functions

Function	Meaning
sin(x)	Sin of an angle x (measured in radians)
cos(x)	cosine of an angle x (measured in radians)
tan(x)	Tangent of an angle x (measured in radians)
asin(x)	Sin^{-1} where x (measured in radians)
acos(x)	Cos^{-1} where x (measured in radians)
exp(x)	Exponential function of x (e^x)
log(x)	Logarithm of x
log10(x)	Logarithm of number x to the base 10
sqrt(x)	Square root of x
pow(x,y)	x raised to the power y
abx(x)	Absolute value of integer number x
fabs(x)	absolute value of real number x

Character Functions

All the character functions require ctype.h header file. The following table lists the function.

String	Functions
isalpha(c)	It returns True if c is a letter (A to Z or a to z) otherwise False.
isdigit(c)	It returns True if c is a digit (0 through 9) otherwise False.
isalnum(c)	It returns True if c is a digit from 0 through 9 or an alphabetic character (either uppercase of lowercase) otherwise False.
islower(c)	It returns True if c as a lowercase letter otherwise False.

isupper(c)	It returns True if c is an uppercase letter otherwise False.
toupper(c)	It converts c to uppercase letter.
tolower(c)	It converts c to lowercase letter.

String Functions

The string functions are present in the string.h header file. Some string functions are given below:

strlen(S)	It gives the no. of characters including spaces present in a string S.
strcat(S1, S2)	It concatenates the string S2 onto the end of the string S1. The string S1 must have enough storage location to hold S2.
strcpy(S1, S2)	It copies character string S2 to string S1. The string S1 must have enough storage locations to hold S2.
strcmp((S1, S2) = = 0) strcmp((S1, S2)>0) strcmp((S1, S2)<0)	It compares S1 and S2 and finds out whether S1 equals to S2, S1 greater than S2 or S1 less than S2.

Console I/O functions

The following are the list of functions

(i) getchar( )

(ii) putchar( )

(iii) gets( )

(iv) puts( )

The header file for above functions is stdio.h. The first two functions deal with single character and last two functions deal with string (group of characters).

getchar( ) function

The getchar( ) function returns a single character from a standard input device (keyboard). It takes no parameter and the returned value is the input character. The general form of the getchar( ) function is:

A = getchar( );

The variable A is of the type character. It inputs a character from the keyboard and assigns it to variable A.

putchar( ) function

The putchar( ) function takes one argument, which is the character to be sent to output device. It also returns this character as a result. The general form of the putchar( ) function is :

putchar(ch);

where ch is a variable of type character.

Example 1

```
# include <iostream.h >

# include <stdio.h>

void main ( )

{

        char ch;

        ch = getchar ( ) ;

        putchar (ch);

}
```

The output of the above program is

The above program takes a character from the keyboard and prints it on the screen.

gets( ) function

The gets( ) function gets a string terminated by a newline character from the standard input stream stdin. The gets ( ) replaces the newline by a null character (\0). It also allows input string to contain white space characters (spaces, tabs).

This statement gets a string and stores it in the variable A.

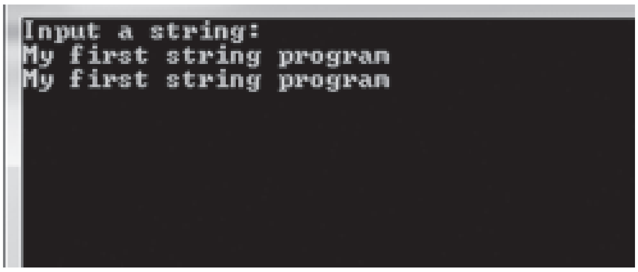
Example:

gets (A) ;

Example 2

```
# include < stdio.h >
# include < iostream.h >
void main ( )
{
        char A [ 100 ];
        cout << "Input a string: \n";
        gets (A);
        puts (A);
}
```

The output of the above program is



Some More Functions

The getch( ) and getche( ) functions

The general form of the getch( ) and getche( ) is

```
ch = getche( ) ;
ch1 = getch( ) ;
```

ch and ch1 are the variables of type character. They take no argument and require the conio.h header file. On execution, the cursor blinks, the user must type a character. The value of the character returned from getche ( ) is assigned to ch. The getche ( ) function echoes the character to the screen. That's why there's an e in getche. Another function, getch ( ), is similar to getche ( ) but does not echo the character to the screen.

Notes

Example 3

To count the number of characters and words in a sentence entered by the user.

```
# include < iostream.h >
# include < conio.h >
void main ( )
{
        char ch;
        int chcnt = 0, wdcnt = 1;
        while ( (ch = getche ( ) ) ! = '\r')
        {
                if (ch = = ' ')
                        wdcnt + + ;
                else
                        chcnt + + ;
        }
cout < < "No. of characters" < < chcnt << "\n"
cout < < "No. of words" < < wdcnt;
}
```

The above program counts the no. of characters and no. of words in a sentence terminated by return key. The '\r' reads the return key character.

INTEXT QUESTIONS 15.1

1. Name the header file that is required for the following :

   (i) abs ( )

   (ii) strcmp ( )

   (iii) clrscr ( )

   (iv) tolower ( )

2. Fill in the blanks :

   a) All header files have an extension ....

   b) Character functions are available in .... header file.

   c) The function toupper (C) converts C to ....

   d) In strcpy (S1, S2) the string................ copies onto the string................

e) The function which counts the length of the string is ....

f) The sin ( ) function is available in .... header file.

3. State whether the following statements are true or false:

a) The isdigit ( ) function checks whether the entered character is digit or not.

b) All string functions are available in stdio.h.

c) The iostream.h contains all input/output functions.

d) The tolower (C) converts C to lowercase.

e) strcat (S1, S2) splits two strings into three strings.

f) pow (x, y) claculates y to the power x.

g) cos (x) returns the cosine of angle (x).

h) tolower ( ) function is available in ctype.h.

i) The log (x) is available in string.h.

15.3 USER DEFINED C++ FUNCTION

A C++ function is a grouping of program statements in a single unit. Do you know that the main ( ) is an essential function in all C ++ programs? If there is a single function in a program, it should be named main ( ). The main ( ) function is the starting point for the execution of a program. The definition of main ( ) would look like as follows :

```
main ( )
{
// main program statements
}
```

In C ++, the main ( ) returns a value of type int to the operating system. The function that have a return value should use the return statement for termination. The main ( ) function, therefore, is defined as follows :

```
void main ( )
{
    cout<<"Welcome";
}
```

Here, the return type of function is void.

Consider the program given below :

```
# include < iostream. h >
void main ( )
{
cout < < "Computer Science \n";
}
```

It prints computer science on the screen. We can also write the above program in the following way:

```
# include < iostream.h>
void message ( );
void main ( )
{
        message ( ) ;
}
void message ( )
{
        cout << "Computer Science\n";
}
```

The above program also prints computer science but it uses a function message( ) for printing. In addition to the functions main ( ) and message ( ), the program has an extra line after # include preprocessor directive. The line is void message ( ). This is known as function prototype.

15.3.1 Function Prototype

The function prototype informs the compiler about the functions to be used in a program, the argument they take and the type of value they return. Functions which do not return any value are known as void functions.

15.3.2 Arguments to a function

Sometimes the calling function supplies some values to the called function. These are known as parameters. The variables which supply the values to a calling function are called actual parameters. The variable which receive the value from called statement are termed formal parameters.

Consider the following example that evaluates the area of a circle.

```
# include < iostream.h >
void area (float);
void main ( )
{
float radius;
cin >> radius;
area (radius ) ;
}
void area (float r)
{
cout << “The area of the circle is ” << 3.1416 *r* r << “\n”;
}
```

The statement area (radius), that invokes the function, may be written as

area (6.0);

This will evaluate and display the area of a circle with radius 6.0. Here radius is called actual parameter and r is called formal parameter.

15.3.3 Return Type of a function

In the above program, area of a circle is displayed in the function area ( ) itself. If the area of a circle is required in the calling function main ( ), the function area ( ) may return the area evaluated to function main ( ). This is possible through the return statement. The program may be written as :

```
# include < iostream. h >
float area (float);
void main ( )
{
        float radius, y;
        cin >> radius ;
        y = area (radius) ;
        cout < < “The area of the circle is ” < < y;
}
float area (float r)
{
        return ( 3.1416 *r* r) ;
}
```

In function prototype, void is replaced by **float**, this indicates that value returned by the function area to main function is float. In the calling function variable y is assigned the value returned by function area ( ). Thus, variable y will be assigned the area of a circle.

15.3.4 Global and Local variables

The variable declared in a program may broadly be classified into following two types;

(i) Local variable

(ii) Global variable

Local variable

A variable declared within the body of a function will be evaluated only within the function. The portion of the program in which a variable is retained in memory is known as the scope of the variable. The scope of the local variable is a function where it is defined. A variable may be local to function or compound statement.

Global variable

A variable that is declared outside any function is known as a global variable. The scope of such a variable extends till the end of the program. These variables are available to all functions which follow their declaration. So it should be defined at the beginning, before any function is defined. If in a program, variable a is declared as local as well as global. Then *a* represents the local variable.

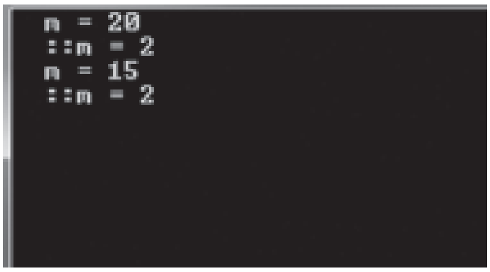
: : *a* represents the global variable. The symbol : : is called scope resolution operator.

Example 4

```
# include < iostream.h >
int m = 2;
void main ( )
{
        int m = 15;
        {
        int m = 10 * : : m;
```

```
        cout < < "m = " < < m < < "\n";
        cout < < ": : m = " < < : : m < < "\n"
        }
        cout < < "m = " < < m < < "\n";
        cout < < ": : m = " < < : :m < < "\n";
}
```

The output of the above program is



Variables and Storage class

The storage class of a variable determines which parts of a program can access it and how long it stays in existence. The storage class can be classified as (i) Automatic (ii) Register (iii) Static (iv) External.

Automatic variable

All variables by default are auto, i.e., the declarations, int a and auto int a are equivalent. Auto variables retain their scope till the end of the function in which they are defined. An automatic variable is not created until the function in which it is defined is called. When the function exits and control is returned to the calling program, the variables are destroyed and their values are lost. The name automatic is used because the variables are automatically created when a function is called and automatically destroyed when it returns.

Example 5

```
# include <iostream.h >
void sum (int);
void main( )
{
        int i;
        for (i = 1; i < =5; i + +)
        sum (i);
}
```

```
void sum (int n)
{
        auto int s = 0;
        s = s + n;
        cout << s << "\n";
}
```

The output of the program is

Register variable

A register declaration is an auto declaration. A register variable has all the characteristics of an auto variable. The difference is that register variable provides fast access as they are stored inside CPU registers rather than in memory. The register and auto can be applied to local variable.

Static variable

The variable may be static automatic variable or static external variable. The later one is meaningful only in multifile programs. A static automatic variable has the visibility of a local variable but the lifetime of an external variable. Thus it is visible only inside the function in which it is defined, but it remains in existence for the life of the program. If in the previous program auto int s = 0 is changed to static int s = 0. The output of the program will be

External variable

A large program may be written by a number of persons in different files. A variable declared global in one file will not be available to a function in another

file. Such a variable, if required by functions in both the files, should be declared global in one file and at the same time declared external in the second file.

Example : extern int a;

where extern is the keyword for external.

15.3.5 Calling of Function

The function can be called using either of the following methods:

(i) call-by-value

(ii) call-by-reference

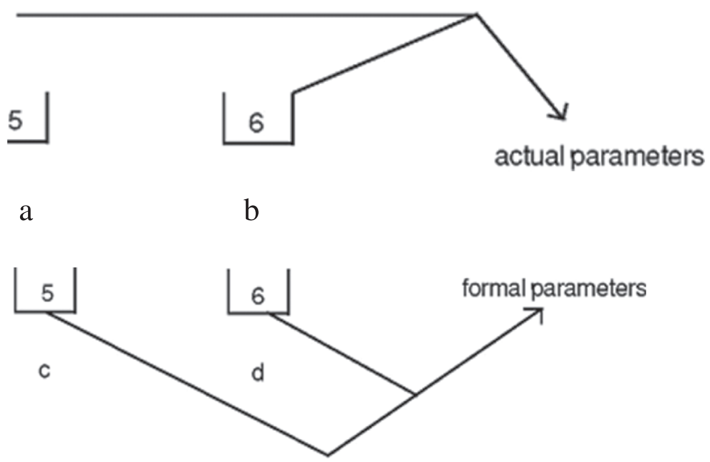
Call-by-value

Consider the following program which will swap the value of two variables using the method call-by-value.

Example 6

```
# include < iostream.h>
void swap (int, int);
void main ( )
{
    int a, b;
    cin >> a >> b;
    swap (a, b);
    cout << a << b << "\n";
}
void swap (int c, int d)
{
    int t;
    t = c;
    c = d;
    d = t;
    cout << c << d << "\n";
}
```

The variables a and b are called actual parameters. When calling the function swap ( ) the value of a is passed onto c and value of b is passed onto d. Here c and d are called formal parameters.



In the function swap ( ), the value are swapped but this change will not be implemented to actual parameters.

The variables which supply the values to a calling function are called actual parameters. The variables which receive the value from called function are called formal parameters.

Call-by-reference

Consider the following program which will swap the value of two variables using call-by-reference method.

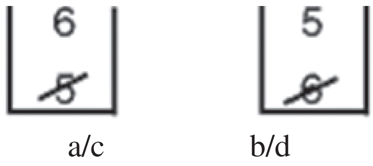
Example 7

```
# include < iostream.h >
void swap (int &, int &);
void main ( )
{
        int a , b;
        cin >> a >> b;
        swap (a, b);
        cout << a << b << "\n";
}
```

Notes

```
void swap (int &c, int &d)
{
        int t;
        t = c;
        c = d;
        d = t;
        cout << c << d << "\n";
}
```

In this method, when the function is called, the address is transferred from actual to formal parameters. It means variables a and c are sharing the same memory address and variables b and d are sharing the same memory address.



So, any change in formal parameter will be implemented to actual parameter.

15.4 INLINE FUNCTION

Functions save memory space because all the calls to the function cause the same code to be executed. The function's body need not be duplicated in memory. When the compiler sees a function call, it normally jumps to the function. At the end of the function, it jumps back to the statement following the call.

While the sequence of events may save memory space, it takes some extra time. To save execution time in short functions, inline function is used. Each time there is a function call, the actual code from the function is inserted instead of a jump to the function. The inline function is used only for shorter code.

Example 8

```
# include < iostream.h >
inline int cube (int r)
{
        return (r*r*r*);
}
void main ( )
{
        int number, y;
        cout << "Enter number";
        cin >> number;
        y = cube (number);
        cout << "The cube of the number is" << y;
}
```

Some important points to be noted:

(i) Function is made inline by putting a word inline in the beginning.

(ii) Inline function should be declared before main ( ) function.

(iii) It does not have function prototype.

(iv) Only shorter code is used in inline function.

(v) If longer code is made inline then compiler ignores the request and it will be executed as normal function.

15.5 FUNCTION WITH DEFAULT ARGUMENTS

C ++ allows to call a function without specifying all its arguments. In such cases, the function assigns a default value to a parameter which does not have a matching argument in the function call. Default value are specified when the function is declared. The compiler knows from the prototype how many arguments a function uses for calling.

Example 9

```
float result (int marks 1, int marks 2, int marks 3 = 75);
```

A subsequent function call

```
Average = result (60, 70);
```

passes the value 60 to marks 1, 70 to marks 2 and lets the function use default value of 75 for marks 3.

The call Average = result (60, 70, 80);

passes the value 80 to marks3.

The important point to note is that only the trailing arguments can have default values.

Consider the following program:

```
# include < iostream.h>
void repchar (char = '=', int = 30);
void main ( )
{
        repchar ( );
        repchar ( '*');
        repchar ('+', 45);
}
void repchar (char ch, int x)
{
        for (int i= 1; i < = x; i + + )
        cout << ch;
        cout << "\n";
}
```

The default argument follows an equal sign, which is placed directly after the type name. In the above program, the function repchar ( ) takes two arguments. It is called three times from main ( ).

- First time it is called with no argument. The function assigns the default value '=' to ch and 30 to x and it print '=' symbol thirty times on the screen.
- Second time it is called with one argument. The function assigns the default value 30 to x and it prints '*' symbol thirty times on the screen.
- Third time it is called with two argument. The actual parameters take priority over the default parameters. It prints '+' symbol forty-five times.

Function Overloading

The same function name can be used to create functions that perform a variety of different tasks. This is known as **function polymorphism** in OOP. The function would perform different operations depending on the argument list in function call. The correct function to be invoked is determined by checking the number and type of arguments. For example, an overloaded function mpy( ) handles different types of data as follows:

```
// Declaration
    void mpy (int, int);          // prototype 1
    void mpy (int, float);        // prototype 2
    void mpy (float, int);        //  prototype 3
    void mpy (float, float);      // prototype 4
// Function calls
    cout < < mpy (3.5, 1.2);      // uses prototype 4
    cout < < mpy (2, 5);          // uses prototype 1
    cout < < mpy (5.2, 6);        // uses prototype 3
    cout < < mpy (7, 6.2);        // uses prototype 2
```

A function call first matches the prototype having the same number and type of arguments and then calls the appropriate function for execution. A best match must be unique.

The function selection involves the following steps:

(i) The compiler tries to find an exact match in which types of actual arguments are the same and uses that function.

(ii) If an exact match is not found, the compiler uses the integral promotions to the actual arguments, such as

    char to int
    float to double

to find a match.

(iii) When either of them fails, the compiler tries to use the built in conversions (the implicit conversions) to the actual arguments then uses the function whose match is unique. If the conversion is possible to have multi matches, then the compiler will generate an error message. Suppose, we use the following two functions:-

```
long abc (long n);
double abc (double x);
```

A function call such as

```
abc (10)
```

will cause an error because int argument can be converted to either long or double, thereby creating an ambiguous situation.

(iv) If all the steps fail, then the compiler will try the user defined conversions in combination with integral promotions and built in conversions to find a unique match.

INTEXT QUESTIONS 15.2

1. What will be the output of the following programs ?

(a)
```
# include < iostream.h>
void add (float);
void main ( )
{
     float x = 5.0;
     add (x);
     cout << x ;
}
void add (float x)
{
      x = x + 2;
}
```

(b)
```
# include < iostream.h >
void add (float);
float x = 5.0;
void main ( )
{
     add (x);
     cout << x ;
}
void add (float x)
{
      x = x + 2;
}
```

(c)
```
# include < iostream.h >
float add (float);
void main ( )
{
     float x = 5.0;
     float y;
```

```
        y = add (x);
        cout << x << " " << y < < "\n"
    }
    float add (float x)
    {
        return (x +2);
    }
```

(d)
```
    # include < iostream.h >
    void P1 (int &, int);
    void main ( )
    {
        int a = 5;
                int b = 6;
                cout << "output of the program \n";
                cout << "values of a and b are " << a << b << "\n";
                P1 (a, b);
                cout << "values of a and b are" << a << b;
        }
    void P1 (int & a, int b)
    {
        a = 7 ;
        b = 10 ;
    }
```

(e)
```
    include < iostream.h >
    int a, b;
    void try2 (int x, int & y);
    void main ( )
    {
        int a = 10 ;
        int b = 7 ;
        try2 (a, b);
        cout << a << b << "\n";
    }
```

```
void try2 ( int x, int & y)
{
    b = x;
    y = y + b;
    x = y;
    cout << x << y << b << "\n";
}
```

2. Fill in the blanks:

   (a) Any C++ program contains at least .... function(s).

   (b) After each function has done a job, control returns to ....

   (c) The declaration of a function in the calling program is known as a function ....

   (d) In a program, the function can be called in two ways .... and ....

   (e) When the return type is not specified, the default return type of function is ....

   (f) To return the control back to the calling function, we use the keyboard ....

   (g) In an .... function, looping is not allowed.

3. State whether the following statements are true or false:

   (a) There is a limit on the number of functions that might be present in a C++ program.

   (b) A variable which is declared inside the function is called global variable.

   (c) When function is not returning anything, return type is void.

   (d) An inline function is preferred when its size is small.

   (e) In call by reference, any change made in the object inside the function will reflect in the value of the actual object.

   (f) A C ++ program can have more than one function with the same name.

   (g) Inline is a keyword in C++ programming language.

   (h) An inline function must be defined before it is called.

   (i) Any function in C++ can be declared as inline function.

   (j) It is necessary to specify the variable name in the function prototype.

Notes

WHAT YOU HAVE LEARNT

- Mathematical functions are defined in math.h file.
- Character functions require ctype.h file.
- String functions are present in the string.h file.
- Functions which do not return any value are known as void functions.
- The variables which supply the values to a calling function are called as actual parameters.
- Variables declared in a program are classified as local variable and global variable.
- Functions can be called using call by value or call by reference methods.
- Inline functions are used in the programs, to save the execution time.

TERMINAL EXERCISE

1. Write a program that will ask the user to enter a single character. Find out whether it is alphabetic, digit or special character.
2. Write a program that will ask the user to enter his/her name. Convert all uppercase letter to lowercase letter and vice-versa.
3. Write a program that will ask the user to enter a character. Check if it is alphabetic or not. If alphabetic, check whether it is in uppercase or lowercase.
4. What is the difference between the following ?

   (i) getchar ( ) & putchar ( )

   (ii) gets ( ) & puts ( )
5. Write a program that will count the number of characters in a sentence entered by user.
6. Write a program that will count the number of words in a sentence entered by the user.
7. Write a program that will count the number of A's, E's, I's, O's and U's in a sentence.
8. Differentiate between the following :

   (i) Actual and Formal parameters

   (ii) Call by value and call by reference
9. What do you mean by inline function ?
10. What are the advantages of function prototype in C++?

11. What is the main advantage of passing the arguments by reference ?
12. When do we need to use default arguments in a function?
13. What do you mean by overloading of a function?
14. Write a program in C++ to call a function which will return the cube of a given number using inline function.
15. Write a program in C++ that prints the largest of two numbers entered from the keyboard. Pass the two numbers to a function as argument, find the largest and return this value to a main function.

ANSWERS TO INTEXT QUESTIONS

15.1

1.	(i) math.h	(ii) string.h	(iii) conio.h	(iv) ctype.h
2.	(a) h	(b) ctype.h	(c) uppercase	
	(d) S2, S1	(e) strlen ( )	(f) math.h	
3.	(a) True	(b) False	(c) True	
	(d) True	(e) False	(f) False	
	(g) True	(h) True	(i) False	

15.2

1. (a) 5 (b) 5 (c) 5 7

   (d) output of the program values of a and b are 5 6 values of a and b are 7 6

   (e) 17 17 10 10 17

2. (a) 1

   (b) statement after calling function statement

   (c) prototype

   (d) call by value call by reference

   (e) int

   (f) return

   (g) inline

3.	(a) False	(b) False	(c) True	(d) True	(e) True
	(f) True	(g) True	(h) True	(i) False	(j) False

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16

ARRAY

In the previous lesson you have learnt about C++ functions. Now you will learn about arrays. Sometimes, it is required to store a large number of variables of the same type. Instead of declaring many variables of the same data type you can use array. Array is a collection of values of same type. The array can be one dimensional (one subscript), two dimensional (two subscripts) or multidimensional (n-subscripts). In this lesson, you will learn to declare an array, initialize array elements, operate on one dimensional array and use array of strings.

OBJECTIVES

After reading this lesson, you will be able to:

- define an array;
- declare and initialize array elements;
- operate on one dimensional array;
- use array of strings;
- declare multidimensional array.

16.1 ARRAY

Array is a collection of values of same data type. For declaring an array you have to use following syntax:

```
datatype array_name[size];
```

For example

```
int A[5];
```

This statement declares an array A which allocates 5 continuous memory locations for storing integer data type. These locations are A[0], A[1], A[2],

Notes

A[3] and A[4]. The number within the square bracket is called index or subscript and in an array index starts with 0 (zero).

Array can be initialized by setting the elements while writing the program, those values will be hard coded values or can be initialized at run-time.

Syntax for initialization of array elements

```
type array_name[size]={ list of elements separated by comma };
```

The list of elements should be separated by commas.

```
int A[5]={1,2,3,4,5,};
```

Here A is an integer array of size 5. A[0] will have the value 1, A[1] will have the value 2, A[2] will have the value 3, A[3] will have the value 4, A[4] will have the value 5.

While initializing the array elements we can leave size as blank, it will automatically count the elements and will set the size.

For example, `int A[ ] ={1,2,3,4,5};`

In the above example we have not initialized the size. It will set the size of the array automatically by counting the number of elements. If the size of array is more than the initialized elements then for non-initialized array elements it will take garbage value.

Initialization of array elements at run-time

```
int A[5];  // declaration of Array
cout<< "Enter  elements " ;
for(i=0;i<=4;i++)
{
cin>>A[i];     // elements will be entered one by one for i=0 to i=4
}
```

Here, A is an integer array of size 5. When you run this program, it will ask the value for A[0], A[1]…. A[4]. Those values will be stored in the array A. Similarly you can declare array of other data types. Now let us learn to access array elements.

Accessing Array Elements

You have to use array's index for accessing the array elements.

For example,

```
int i;
int A[2]={10,20,30};
for (i=0; i <= 2; i++)
{
        cout << A [i] ;
}
```

This program will display A[0], A[1] and A[2] values as 10, 20 and 30 respectively.

16.1.1 Processing an Array

The various operations that can be performed on arrays are

- Traversal
- Searching
- Sorting
- Insertion
- Deletion

Traversal

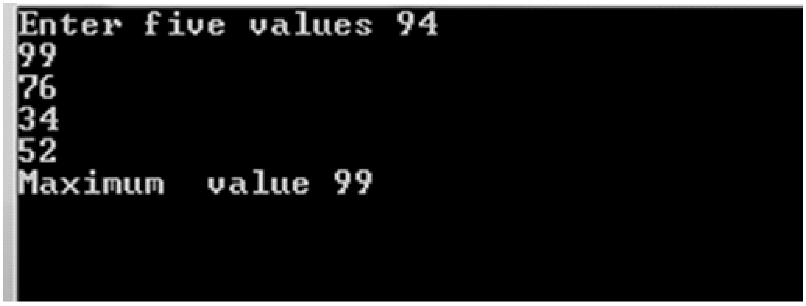
It means to access each location of an array may be for display purpose. Let us consider a program which will read five values from the user and finds out the maximum value.

Example 1

```
# include < iostream.h >
void main ( )
{
        int T, A[5], i;
        cout < < "Enter five values";
        for ( i = 0; i < 5; i++)
        cin > > A [ i ];
        T = A [ 0 ];
        for (i = 1; i < 5; i++)
```

```
                {
                if (T < A [i])
                T = A [ i ];
                }
        cout < < "Maximum value" < < T;
}
```

Output of the program



Searching

This method finds out whether the data entered by the user is present in an array or not. There are two types of searching method.

(i) Linear or Sequential search

(ii) Binary search

Linear or sequential search

This method is slower, inefficient and works on unsorted list. If the data we are searching is not present in the list, we come to know at the end of the list.

Example 2

```
/ / Linear search
# include < iostream.h >
void main ( )
{
        int A[5], i, data, flag = 0;
        cout < < "Enter five values";
        for (i = 0; i < 5; i++)
        cin > > A [i];
        cout << 'Enter data to be searched";
```

Notes

```
        cin >> data;
        for (i=0; i < 5; i ++)
                {
                if (A[i] = = data)
                flag = 1;
                }
        if (flag = = 1)
        cout < < "Data present";
        else cout << "Data not present";
}
```

Output of the program

Binary search

This method requires the array to be either in ascending or descending order. This method calculates the mid location from initial and final locations and compares the data with the value present in mid location. Consider the case where the list is in ascending order. If data is less than a [mid] then data is present in the upper half otherwise data is present in the lower half. The value of either final or initial will be changed. The mid value is calculated again and searching continues till the data is found or initial is greater than final. The values of initial, final and mid for searching a value of **35** in an ascending order sorted list containing 9 elements is shown below:

Let the array have value:

	10	15	18	20	27	30	35	40	45
location	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Initial	Final	Mid $= \frac{\text{Initial} + \text{Final}}{2}$	A[Mid]
0	8	4	27
5	8	6	35
			Search is successful

Example 3

```
/ / Binary search
# include < iostream.h >
const int N = 10;
void main ( )
{
int A[N], i, initial, final, mid, data;
cout < < "Enter nine values in ascending order";
for (i = 0; i < N; i++)
cin >> A [ i ];
cout << "Enter data to be searched";
cin >> data;
initial = 0;
final = N - 1;
mid = (initial + final) / 2;
While ((initial < = final) & & (A[mid]! = data))
{
if (A [mid] > data)
final = mid - 1;
else
initial = mid + 1;
}
if (A [mid] = = data)
cout << "data is present";
if (initial > final)
cout <<"data not present in the list";
}
```

Output of the program

```
Enter nine values in ascending order
23
24
25
26
27
28
29
30
31
32
Enter data to be searched 27
data is present
```

The advantage of Binary search is that each search cuts the list in to half. A list of 10,000 names can be searched in just 12 searches.

Sorting

It is a method to arrange the list either in ascending or descending order.

Bubble sort

Consider an array of five locations to be sorted in ascending order:

	–1	9	5	0	2
Index	0	1	2	3	4

In this sorting method, A[0] is compared with A[1]. If A[0] is greater than A[1], the values are swapped. Then A[1] is compared with A[2], A[2] is compared with A[3], and A[3] is compared with A[4]. In all cases if the i^{th} location has value greater than $i + 1^{th}$ location, the values are swapped. The entire process is repeated N-1 times where N is the number of data in an array.

Example 4

```
# include < iostream.h >
const int N = 5;
void main ( )
{
        int A [N], i, j, T;
        cout << "Enter values";
        for (i = 0; i = N; i ++)
```

```
        cin >> A [ i ];
        / / sorting
        for ( i = 0; i < N - 1; i ++)
        for (j = 0; j < N - i; j ++)
        if (A[j] > A [j + 1])
                {
                T = A [ j ];
                A [ j ] = A [ j + 1 ];
                A [ j + 1 ] = T;
                }
        cout << "Sorted array is \n";
        for (i = 0; i < N; i ++)
        cout << A [ i ]<< "\n";
}
```

Output of the program

```
Enter values
63
62
5
6
7
Sorted array is
5
6
7
62
63
```

Selection sort

Consider an array having N elements to be sorted in ascending order. Initially, first element is compared with others so that it holds the smallest value. In the next pass, second element is compared with others so that it holds the second smallest value. This procedure is repeated for the entire array.

Example 5

```
# include < iostream.h >
const int N = 5;
void main ( )
{
int A [N], i, j, T;
cout << “Enter values”;
for ( i = 0; i < N; i ++ )
cin >> A [ i ];
/ / sorting
for ( i = 0; i < N - 1; i ++ )
for (j = l; j < N; j ++ )
if (A [ i ] > A [j])
{
T = A [i];
A [i] = A [j];
A [j] = T;
}
// printing the sorted data
for ( i = 0; i < N; i ++ )
cout < < A [ i ];
}
```

Output of the program

```
Enter values
6
45
84
62
59
Sorted array is
6
45
59
62
84
```

Insertion

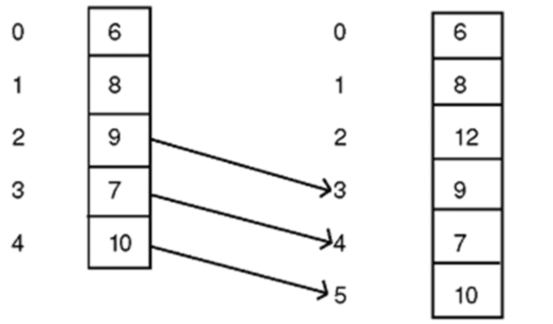
It means addition of a data item in the middle or at the end of the array. If data is to be added after a given data item then the location of the data item is first

determined by applying search procedure and then the insertion procedure is implemented.

Example 6

```
# include < iostream.h >
void main ( )
{
int x [20];
int i, loc, n, data;
cout << "Enter the no. of elements";
cin >> n;
for (i = 0; i < n; i ++ )
{
cout << "Enter the array element";
cin >> x [ i ];
}
cout << "Enter the location after which data is to be inserted";
cin >> loc;
for (i = n - 1; i > = loc; i - - )
x [ i + 1 ] = x [ i ];
cout << "enter the new data to be added";
cin >> x [loc];
n ++ ;
cout << "Array elements after insertion";
for (i = 0; i < n; i ++)
cout << x [ i ];
}
```

Let data 12 to be inserted at location 2



Before insertion After insertion

Notes

Deletion

It means removal of a data. First the location of the item to be deleted is determined by applying an appropriate search procedure and then the value present at particular location will be deleted.

Example 7

```
# include < iostream.h >
void main ( )
{
int x [20];
int i, j, n, loc, data;
cout << "Enter the no. of elements";
cin >> n;
for (i = 0; i < n; i ++)
{
cout << "Enter value";
cin >> x [ i ];
}
cout << "Enter the location to be deleted";
cin >> loc;
if (loc ! = 0)
{
data = x [loc ];
for {j = loc; j < n - 1; j ++ )
x [ j ] = x [ j + 1];
}
n = n - 1;
cout << "Elements after deletion";
for ( i = 0; i < n; i ++)
cout << x [ i ];
}
```

16.2 ARRAY OF STRINGS

Array of string is nothing but an array of characters.

Syntax for declaring an array of string is:

char array_name [size]={array of character in single quotes separated by commas}

For example, char name[5]={'G','A','U','R','A','V'};

String is a series of character stored in continuous memory location. The last character of each string is a null character '\0'. Actually, you do not place the null character at the end of a string constant. The C++ compiler automatically places the '\0' at the end of the string when it initializes the array.

For example, char name[6]={'G','A','U','R','A','V','\0'};

INTEXT QUESTIONS 16.1

1. Write a statement that defines one dimensional array called student of type int that holds 5 data elements.

2. In the following array declarations find the number of elements in each array and total no. of bytes required to store each array.

   (a) int A [20];

   (b) char z [18] ;

3. What will be the output of the following programs?

   (a)
```
# include < iostream.h >
void main ( )
{
        int a [ 5 ], t ;
        for (i= 0; i < 5; i ++ )
        a [i] = 5 * i;
        for (i = 0; i < 5; i ++)
        cout << a [ i ];
}
```

   (b)
```
# include < iostream.h >
void main ( )
{
        char title [ ] = "Computer";
        for ( int i = 0; title [ i ]; i ++)
        cout << "\n" << (title + i);
}
```

Notes

16.3 TWO-DIMENSIONAL ARRAY

It has two subscript or index, first for row and second for column. For example:

```
int A [ 5 ] [ 4 ];
```

The above has five rows and four columns. The total number of elements are 20. The subscripts of 20 elements are:

A[0][0]	A[0][1]	A[0] [2]	A[0][3]
A[1][0]	A[1][1]	A[1] [2]	A[1][3]
A[2][0]	A[2][1]	A[2] [2]	A[2][3]
A[3][0]	A[3][1]	A[3] [2]	A[3][3]
A[4][0]	A[4][1]	A[4] [2]	A[4][3]

Initialization of Two Dimensional Array

The initialization is done at the time of declaration of an array.

You can create multi-dimentional arrays like int A[ ] [ ] [ ], float B [ ] [ ] [ ] [ ] etc.

For example:

```
int A [2] [4] = {1, 2, 3, 4, 5, 6, 7, 8};
```

For more clarity

```
int A [2] [4] = { {1, 2, 3, 4 }, {5, 6, 7, 8} };
```

The above data can be grouped. The inner braces are ignored by the compiler.

Initialization of array elements at run-time

You can initialize array elements at run time.

```
Let int A[3][2];  // declaration of Array

cout<<"Enter  elements "

for(i=0;i<3;i++)          //1st for loop for row

{

    for(j=0;j<2;j++)      // 2nd for loop for column

    cin>>A[i][j];

}
```

Accessing Array Elements

Accessing array elements is same as reading elements.

Let us take an array int A[3][2]= {{1,2},{3,4},{5,6}};

For accessing/reading elements we will use following code:-

```
int A[3][2];                // of Array
cout<<"Enter elements"
for(i=0;i<3;i++)            //1st for loop for row
{
      for(j=0;j<2;j++)
      cout<<A[i][j];
}
```

The following program finds out the maximum value stored in two dimensional array.

Example 8

```
# include , <iostream.h >
const int M = 5;
void main ( )
{ int A [M] [M], i, j, T;
cout >> "\n Enter Array Elements";
for (i = 0; i < = M - 1; i ++ )
for (j = 0; j < = M - 1; j ++ )
cin >> A [i] [j];
T = A [0] [0];
for ( i = 0; i < = M – 1; i ++)
for (j = 0; j < = M – 1; j ++)
{ (if (T < A [ i ] [ j ])
T = A [ i ] [ j ];
}
cout << "Largest value" << T << "\n";
}
```

INTEXT QUESTIONS 16.2

1. Define a two dimensional array A having 2 rows, 3 columns and stores int data type.
2. Consider the following array declarations. Find the number of elements in each array and total number. of bytes required by each array.

   (a) int x [5] [10];

   (b) long y [5] [10];

WHAT YOU HAVE LEARNT

- Array is a collection of values of same type.
- On one dimensional array you can perform the operations like traversing, searching, sorting.
- Traversing of an array means accessing all the elements of the array one by one.
- Searching is the process of finding an element within the array list.
- Sorting is a method to arrange the list either in ascending or descending order.
- Two dimensional array has two subscripts or index.
- You can initialize array elements at run time.

TERMINAL EXERCISE

1. What is the need of an array?
2. What do you mean by searching?
3. What do you mean by sorting?
4. Write a program that will read 20 float values in a one dimensional array and find out the following:

   (i) Number of values greater than zero.

   (ii) Number of values equal to zero.

   (iii) Number of values less than zero.

5. Write a program that will find out the sum of two diagonals of two dimensional array of A [N] [N].

6. Write a program to search whether the element entered by the user is present in a one dimensional array of 10 elements or not.

ANSWERS TO INTEXT QUESTIONS

16.1

1. int student [5];

2. (a) Number of elements - 20 Total number of bytes - 40

   (b) Number of elements - 18 Total number of bytes - 18

3. (a) 0 5 1015 20

   (b) COMPUTER

   OMPUTER

   MPUTER

   PUTER

   UTER

   TER

   ER

   R

16.2

1. int A [2] [3];

2. (a) Number of elements - 50

   Total number of bytes - 100

   (b) Number of elements – 50

   Total number of bytes - 200

330en17

17

STRUCTURE, TYPEDEF & ENUMERATED DATA TYPE

In the previous lesson you have learnt that array is a collection of values of same data type. Sometimes it is required to store information, which can be of same or different types. For this purpose, structure statement is used in C++ programming language. In this lesson you will learn three important statements structure, typedef and enumerated data type of C++ programming language.

OBJECTIVES

After reading this lesson, you will be able to:

- define variable, initialize and access members of the structure;
- explain the concept of nested structure;
- explain typedef statement in a program;
- define enum statement and use it.

17.1 STRUCTURE

A structure is a collection of simple variables which can be of same or different types. It is a user defined datatype which allows you to combine different data types to store a particular type of record. The data items in a structure are called the members of the structure. Consider the following example:

Example 1

```
# include < iostream.h >
struct student
{ char name [20]; int marks;
};
```

```
void main ( )
{
student S1, S3;
cin >> S1. name >> S1. marks;
cout << S1. name << S1. marks <<"\n";
student S2 = {"ANKIT", 32};
cout << S2. name << S2. marks <<\n";
S3 = S2; cout << S3. name << S3. marks;
}
```

Output of the above program is

Variable of the structure

S1 and S2 are called variable of the structure student. They are given enough space in memory to hold the members of the structure (22 bytes each for above program).

Accessing of data members

The accessing of data members is done by using the following format:

structure variable. member name

Initialization of structure variable

Initialization is done at the time of declaration of a variable. For example:

Student S2 = {"ANKITA", 32};

Structure variable in assignment statements

The statement S3 = S2;

assigns the value of each member of S2 to the corresponding member of S3. Since a large structure can have many members, such an assignment statement requires the compiler to do a considerable amount of work.

Notes

One structure variable can be assigned to another only when they are of the same structure type, otherwise compiler will give an error message.

17.1.1 Structure within Structure

This is called nesting of structure. Consider the following program in which date field is a structure.

Example 2

```
# include < iostream.h >
# include < stdio.h >
struct today
{
        int month;
        int date;
        int year;
};
struct biodata
{
        char name [ 20 ];
        today date_of_birth;
        char add [ 30 ];
};
void main ( )
{
        biodata b;
        cout << "Enter name";
        gets (b.name);
        cout << "Enter birth month";
        cin >> b.date_of _birth. month;
        cout << "Enter birth date";
        cin >> b.date_of_birth.date;
        cout << "Enter birth year";
        cin >> b.date_of _birth.year;
        cout << "Enter address";
        gets (b.add);
        cout << "Name" << b.name << "\n";
        cout << "Month" <<b.date_of_birth.month << "\n";
        cout << "Date" << b. date _of_birth. date << "\n";
        cout << "Year" << b. date_of_birth.year << "\n";
        cout << "Address" << b.add << "\n";
}
```

Accessing nested structure members

As the structure is nested inside another, you must apply the dot operator twice to access the structure members:

cin >> b. date_of_birth. month;

Initializing Nested Structure

It is initialized at the time of declaration of structure variable. For example:

biodata bd = {"MOHIT", {3, 21, 1991}, "Rohini"};

The inner braces are required just to separate the values, although it is ignored by the compiler.

17.2 TYPEDEF

It is used to define a new name for an existing data type. It provides an alternative name for standard data type. It is used for self documenting the code by allowing descriptive names (for better understanding) for the standard data type.

The general format is:

typedef existing datatype new datatype;

For example:

typedef float real;

Now, in a program you can use datatype real instead of float. You can declare an amount variable of type real by using the statement **real amount**;

INTEXT QUESTIONS 17.1

Fill in the blanks:

1. Structure is a collection of simple variables which can be of ....
2. Typedef is used to define .... for an existing data type.
3. .... is the syntax of accessing data members of the structure.

4. What will be the output of the following programs.

(a)
```
# include < iostream.h >
void main ( )
{
struct rollno { int roll; };
rollno r;
r. roll = 100;
cout << "roll = " << r. roll;
}
```

(b)
```
# include < iostream.h >
    void main ( )
    {
    struct student
    {
    int roll;
    int age; };
    student S1 = { 100, 15 };
    student S2 = S1;
    if ( S1 = = S2 )
    cout << "The structures are equal";
    else
    cout << "The structures are not equal";
```

17.3 ENUMERATED DATA TYPE

Enumerated data type works if you know in advance a finite list of values that a data type can take. It has the following features:

- It is a user defined datatype.
- It works if you know in advance a finite list of values that a data type can take.
- The list cannot be input by the user or output on the screen.

Notes

For example:

```
enum months { jan, feb, mar, apr, may};
enum days { sun, mon, tue, wed, thu };
enum toys { cycle, bicycle, scooter };
```

The enum specifier defines the set of all names which are permissible values of the type called members which are stored internally as integer constant. The first name was given the integer value 0, the second value 1 and so on.

Example 3

jan = 0, feb = 1, mar = 2, apr = 3, may = 4

The ordering can be altered by using an equal sign and value.

```
enum months { jan = 1, feb, mar, apr, may };
```

Here jan = 1, feb = 2, mar = 3, apr = 4, may = 5

The value of the next element in the list is previous value plus one.

```
Enum color { red, green = 5, blue };
```

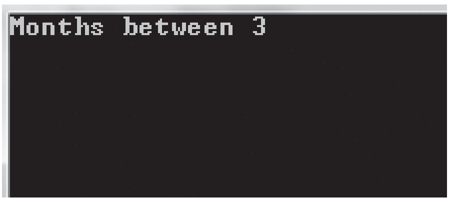
The value of blue will be 6

An enum variable takes only one value out of the possible values.

For example:

```
# include < iostream.h >
enum months { jan, feb, mar, apr, may };
void main ( )
{
months m1, m2;
m1 = jan;
m2 = apr;
int diff = m2 - m1;
cout << “Months between” << diff << “\n”;
if (m1 > m2) cout << “m2 comes before m1”;
}
```

The output of the above program is



Notes

The members of the enumerated series is stored as integer constant in the memory. This is the reason our program displays value 3 (m2 = apr i.e., m2 = 4, m1 = jan i.e., m1 = 1. so diff = m2 – m1 = 4 – 1 = 3).

INTEXT QUESTIONS 17.2

1 What is the meaning of the following statement?

```
enum days { sun, mon, tue };
```

2 Can the enum data input by the user?

3 (a) Write a statement that declares an enumerated data type called months with the values jan, feb, mar, apr, may, jun, jul, aug, sep, oct, nov, dec

(b) Define two variables m1 and m2 and assign them the values jan and mar respectively.

4 Write a statement that declares an enumerated data type called colour with the values pink, red, green, and blue. Give these four names the integer values 33, 45, 58 and 78.

WHAT YOU HAVE LEARNT

- Structure is a collection of simple variables which can be of same or different types.
- Typedef is used to define new data type for an existing data type.
- Typedef provides alternative name for standard data type.
- Enumerated data type is a user defined data type, it works if you know in advance a finite set of values that a data type can take.
- Enum specifier defines the set of names which are stored internally as integer constant.

TERMINAL EXERCISE

1. What is a structure? Write a structure specification in C++ for the record given below:

   Code: A string of 5 characters (including null)

Cost: Integer
Margin: Integer
Call this structure item.

2. What will be the output of the following program?

```
# include < iostream.h >
enum days { sun, mon, tue, wed, thu, fri, sat };
void main ( )
{
days today;
for (today = sun; today < = sat; today ++ )
cout << "\n today is " << today;
}
```

3. State the reason why

```
enum boolean {false, true};
```

is better than

```
enum boolean {true, false};
```

4. What is the advantage of typedef statement?

5. A phone number, such as 786-6370, can be thought of having two parts; the exchange code and the number. Write a program in C++ that uses a structure phone to store these two parts. Call the structure phone. Create two structure variable of type phone. Initialize one and have the user input a number for the other one. Then display both the numbers.

ANSWERS TO INTEXT QUESTIONS

17.1

1 is a collection of simple variables which can be of same or different types.

2 new data type

3. structure variable. member

4. (a) 100

   (b) The structures are equal

Notes

17.2

1. sun = 0, mon = 1, tue = 2   2. No

3. (a) enum months

   { jan, feb, mar, apr, may, jun, jul, aug, sep, oct, nov, dec }

   (b) months m1, m2;

   m1 = jan;

   m2 = mar;

4. enum colour {pink = 33, red = 45, green = 58, blue = 78 };

18

330en18

CLASSES AND OBJECTS WITH CONSTRUCTORS/ DESTRUCTORS

In the previous lesson you have learnt about structure, typedef and enumerated data types. In object oriented programming, the emphasis is on data rather than function. Class is a way that binds the data & function together. Constructor is a specially designed class and destructor returns the memory addresses back to the system. In this lesson you will learn about classes, objects with constructors and destructors.

OBJECTIVES

After reading this lesson, you will be able to:

- define class and object;
- access the members of the class;
- learn about three visibility modes: public, private and protected;
- define constructor with default arguments;
- use destructor.

18.1 CLASS

A class is a way to bind the data and its associated functions together. It allows data functions to be hidden, if necessary from external use. A class specification has two parts.

(i) Class declaration

(ii) Class function definitions

The general format of a class declaration is

```
class class_name
{
private :
    variable declarations;
    function declarations;
public:
    variable declarations;
    function declarations;
protected :
    variable declarations;
    function declarations;
};
```

The keyword class is followed by the name of the class. The body of the class is enclosed between braces and terminated by semi-colon. The class body contains the declaration of variables and functions. These are collectively called **members**. The variables declared inside the class are called as data members. The functions are known as **member functions**. The keywords public, private and protected are called as **visibility modes / access specifiers**.

> *By default, the members of a class are private. Private data members and private functions can be accessed only by member functions of a class. Public members can be accessed from outside of the class.*

The data member and member functions present in private and protected mode can be accessed by the member function in public mode. The private and protected modes are exactly the same except that protected can be inherited (explained later in this lesson) but private mode cannot be inherited. The data member and member functions present in public mode can be accessed within the class and also by other class of same program.

The use of keyword private is optional. By default, the members of a class are private. If the labels are missing, members are private by default.

Class Example;

```
                      Class Employee          // class name Employee
                    ┌ { int emp_no;           // variable … by default private
Body of class       │ public:
                  ← │ void get_emp_no( );     // function declaration
                    │ void put_emp_no ( );    // function declaration
                    └ }
```

Example 1 Program to get and display Student data

```
# include < iostream.h >
class student
{
private :
    char name [ 80 ];
    int rn ;
    float marks ;
private :
    void getdata ( ) ;
    void putdata ( ) ;
};
void student : : getdata ( )
{
    cin >> name >>rn >> marks ;
}
void student : : putdata ( )
{
    cout << name << rn << marks ;
}
void main ( )
{
    student st ;
    st.getdata ( ) ;
    st.putdata ( ) ;
}
```

18.1.1 Creating Objects

An object is an instance of a class and it can be created by using class name.

In example 1 we have created object as

student st ;

Object can be created when a class is defined by placing their names immediately after the closing brace.

```
class student
{
} x, y, z ;
```

The above definition would create the object x, y and z of type student.

Accessing class member

Through object, data member and member function present in public can be accessed. The general format is :

Object name . data member ;

Object name . member function ;

The dot operator is called the **class member access operator**.

In example 1 we have accessed class member as st.getdata( ) and st.putdata( ).

Defining member function

Member function can be defined in two ways (i) inside the class, (ii) outside the class.

(i) Inside the class: When a member function is defined inside a class, it is considered to be **inline** by default. If a member function is very small then it should be defined inside the class.

The class declaration of example 1 can be as follows:

```
class student
{
    char name [ 20 ];
    int rn ;
    float marks ;
    public :
    void getdata ( )
    {
        cin >> name >> m >> marks ;
```

```
        }
        void putdata ( )
        {
                cout << name << rn << marks;
        }
    };
```

(ii) Outside the class: When a function has larger code then it should be defined outside the class declaration. The prototype of such functions, however, must be provided in the class definition. The operator ': :' is known as scope resolution operator and is used to associate member functions to their corresponding class.

The format is :

return _type class_name : : function_name

Notes

18.1.2 Nesting of member functions

A member function can be called by using its name inside another member function of the same class. This is known as **nesting of member functions**. The following program illustrates this concept.

```
class greatest                          //class name
{
    int x, y, z ;                       //by default public
    public :
    void getdata ( ) ;                  //function declaration
    void display ( ) ;
    int largest ( ) ;
};
int greatest : : largest ( )            //function definition outside class
{
    int T ;
    if ( x > y )
            T = x ;
```

```
    else
            T = y ;
    if ( T > z )
            return ( T ) ;
    else
            return ( z ) ;
}
void greatest : : getdata ( )          //function definition outside class
{
    cout <<"Enter values of x, y, z" << "\n";
    cin >> x >> y >> z ;
}
void greatest : : display ( )          //function definition outside class
{
    cout << "largest value" << largest ( ) << "\n"; //nesting of member function
}
void main ( )
{
    greatest A;                        //object of class
    A. getdata ( );             //accessing class members with dot operator
    A. display ( );
}
```

18.1.3 Memory Allocation for objects

The member function are created and placed in the memory space only once when they are defined in class specification. All the objects belonging to that class use the same member functions. Space for member variable is allocated separately for each object because member variable holds different value for different objects.

Array of object

Consider the following program.

```
class emp
{
    char name [ 30 ] ;
    int empno ;
    public :
    void getdata ( ) ;
    void putdata ( ) ;
};
void main ( )
{
    emp e [ 10 ] ;
    for ( i = 0; i < 10; i ++)
    e [ i ]. getdata ( ) ;
    for (i = 0; i < 10; i ++ )
    e [ i ].putdata ( );
}
```

In the above program, the ten objects are created, namely, e [0], e [1], ... e [9].

The statement e [i]. getdata ( ) will get the data of the i^{th} element of the array e.

INTEXT QUESTIONS 18.1

1. Fill in the blanks:
   (a) All members of a class are .... by default.
   (b) .... is an instance of a class.
   (c) To define member function outside the class .... operator is used.

Notes

(d) Operator : : is known as .... operator.

(e) The variables declared inside the class are called as ....

2. State whether the following statements are true or false:

(a) A class contains only private data members.

(b) A class member is accessed using dot operator.

(c) The class declaration must end with a semicolon.

(d) Scope resolution operator is always used for defining the member functions outside the class declaration.

18.2 CONSTRUCTOR

A constructor is a special member function that initializes the objects of its class automatically when it is created. It is special because its name is the same as the class name. It is invoked automatically whenever an object is created. It is called constructor because it constructs the values of data members of the class. It does not have any return data type, not even void.

A constructor is declared and defined as follows:

```
class student
{
int rn;
int total ;
public :
    student ( )              // constructor
    {
        rn = 0 ; total = 0 ;
    }
} ;
```

Constructor should be declared in the public section. It does not have any return data type hence it can not return any values.

The declaration

student st ;

Invokes the constructor, student ( ) and assigns the value 0 to rn and total variables.

18.2.1 Default Constructor

A constructor that accepts no parameter is called default constructor. If no such constructor is defined, then the compiler supplies a default constructor. In that case, it is called **nothing-to-do constructor**.

18.2.2 Parameterized Constructors

The constructors that can take arguments are called parameterized constructors.

```
class student
{
int rn, total ;
public:
    student (int x, int y)          // Parameterized constructor
    {
    rn = x ; total = y ;
    }
} ;
```

When the object is created, we must supply arguments to the constructor function. This can be done in two ways:

- By calling the function explicitly
- By calling the function implicitly

The first call is implemented as follows :

```
    student S1 = student ( 1, 70 ) ;
```

The second call is implemented as follows :

```
    student S1 ( 1, 70 ) ;
```

The second method is used very often as it is shorter.

18.2.3 Copy Constructor

A copy constructor takes a reference to an object of the same class as itself as an argument. Consider the following program segment:

```
class student
{
int rn, total ;
public :
    student (int x, int y )          // Parameterized constructor
    {
        rn = x ; total = y ;
    }
```

```
    student (Student &i )              // copy constructor
    {
        rn = i. rn ;
        total = i. total ;
    }
};
```

The above program has both parameterized and copy constructor. The statement

```
student S1 ( 1, 75 ) ;
```

calls the parameterized constructor and assigns 1 to rn and 75 to total. The statement

```
student S2 (S1) ;
```

uses copy constructor and initializes an object S2 from another object S1. Another form of the statement is

```
student S2 = S1 ;
```

The process of initialization through a copy constructor is known as copy initialization.

Note that the statement

```
S2 = S1 ;
```

does not invoke the copy constructor. However, it simply assigns the value of S1 to S2, member by member.

18.2.4 Constructor with default arguments

The constructor can be declared with default arguments.

For example :

```
student ( int rn, int total = 0 ) ;
```

Here the default value of total is zero.

Then the statement

```
student S1 ( 2 ) ;
```

assigns the value 2 to rn and 0 to total.

However, the statement

```
student S2 ( 3, 75 ) ;
```

assigns 3 to rn and 75 to total. In this case actual parameter takes the priority over default parameter. All default values should be on the right side.

Consider the following statement

student (int = 0) ;

It has only one argument. It can be called in two ways.

student si( ) ;

student si(5) ;

In the first statement, no parameter is supplied. In the second statement, one parameter is supplied. When no parameter is supplied, it becomes a default constructor. When both the forms are used in a class (default constructor and constructor with one default argument), it causes ambiguity for a statement such as

student si;

(whether to call student ( ) or student (int = 0).

18.3 DESTRUCTOR

It is used to destroy the objects that have been created by a constructor. The destructor is a member function whose name is the same as the class name but is preceded by a tilde. For example the destructor of the class student can be defined as

~student ( ) ;

It never takes any argument nor does it return any value. It will be invoked by the compiler upon exit from the program (or function or block) to clean the storage. It is a good practice to declare destructor in a program because it releases memory space for future use.

INTEXT QUESTIONS 18.2

1. Fill in the blanks:

   (a) A constructor name is the same as ....

   (b) A constructor is executed automatically when an object is ....

   (c) Destructor is executed .... at the end of the program.

   (d) A class can have any number of constructors but only .... destructor at a time.

   (e) The name of the destructor function is same as that of class but preceded with a symbol ....

   (f) The constructor which accepts value from outside is called .... constructor.

2. State whether the following statements are true or false:
   (a) A constructor name is not the same as class name.
   (b) In a class, you can have more than one constructor with the same name.
   (c) Constructor does not return any value.
   (d) A constructor that accepts no parameter is known as default constructor.
   (e) Destructor never takes any arguments.
   (f) Destructor is called automatically at the end of compound statement, function or main program.
   (g) Constructor initializes the data members of a class.

WHAT YOU HAVE LEARNT

- Class is a way to bind the data and its associated functions together.
- Object is an instance of a class.
- Member function can be defined inside the class and outside the class.
- Member function can be called by using its name inside another member function of the same class. This is known as nesting of member functions.
- Constructor is a special member function that initializes objects of its class. It is special because its name is the same as the class name.
- Constructor that accepts no parameter is called default constructor.
- Constructors that take arguments are called parameterized constructors.
- Destructor is used to destroy the objects that have been created by a constructor.

TERMINAL EXERCISE

1 What do you understand by visibility modes in class derivations ? What are these modes?

2 Define a class Teacher with the following specifications :

   Private members :

Name	20 characters
Subject	10 characters
Basic, DA, HRA	float
Salary	float

Calculate ( ) function computes the salary and returns it. Salary is sum of Basic, DA and HRA

Public members :

Readdata ( ) function accepts the data values and invokes the calculate function.

Displaydata ( ) function prints the data on the screen.

3. Define a class worker with the following specifications :

Private members of class worker

wno	integer
wname	25 characters
hrwk, wgrate	float (hour worked and wage rate per hour)
totwage	float (hrwk * wgrate)
calcwg ( )	A function to find
	hrwk * wgrate with float return type.

Public members of class workder

In_data ( )	a function to accept values for wno, wname, hrwk, wgrate and invoke calcwg ( ) to calculate netpay.
Out_data ( )	a function to display all the data members on the screen

4. What are the special properties of a constructor function?
5. What is parameterized constructor?
6. What is copy constructor ?
7. What is the importance of destructors ?

ANSWERS TO INTEXT QUESTIONS

18.1

1. a) private b) object
   c) : : d) Scope resolution
   e) data members.

2. a) False b) True
c) True d) True

18.2

1 a) class name b) created
c) automatically d) one
e) tilde (~) f) parameterized

2 a) False b) True
c) True d) True
e) True f) True
g) True

19

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INHERITANCE EXTENDING CLASSES

In the previous lesson you have learnt about constructors and destructors. Now you will learn about inheritance which is one of the key features of object oriented programming. The most important advantage of inheritance is code reusability. Once a base class is written and debugged, it can be used in various situations without having to redefine it or rewrite it. Reusing the existing code saves time, money and efforts of writing the code again. Without redefining the old class, you can add new properties to desired class and redefine an inherited class member function. In this lesson you will learn types of inheritance, visibility modes, abstract class, and virtual base class.

OBJECTIVES

After reading this lesson, you will be able to:

- explain the concept of inheritance;
- describe the five types of inheritance;
- explain all three visibility modes;
- describe the concept of abstract class & virtual class.

19.1 INHERITANCE

Inheritance is a process of deriving a new class from an existing (base) class. The new class is referred to as **derived class**. The existing class is called as **base class**.

Inheritance is one of the important concepts of object-oriented language. There are several reasons why this concept was introduced in object oriented language.

Some major reasons are:

(i) The capability to express the inheritance relationship which ensures the closeness with the real world model.

(ii) Idea of reusability, i.e., the new class can use some of the features of old class (base class).

(iii) Transitive nature of inheritance, i.e., it can be passed on further.

19.2 TYPES OF INHERITANCE

The mechanism of deriving a new class from an old one is called inheritance (or derivation). There are various types of inheritance.

(i) Single inheritance: A derived class with only one base class is called as single inheritance.

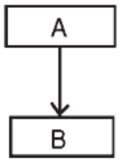

Fig. 19.1: Single Inheritance

(ii) Multiple inheritance: A derived class with several base classes is called as multiple inheritance.

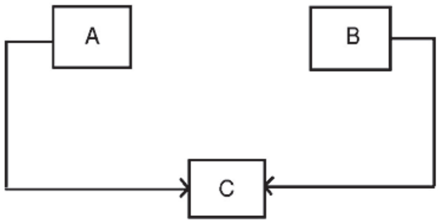

Fig. 19.2: Multiple Inheritance

(iii) Multilevel inheritance: The mechanism of deriving a class from another derived class is called as multilevel inheritance.

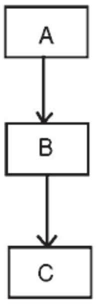

Fig. 19.3: Multilevel Inheritance

(iv) Hierarchical inheritance: One class may be inherited by more than one class. This process is known as hierarchical inheritance.

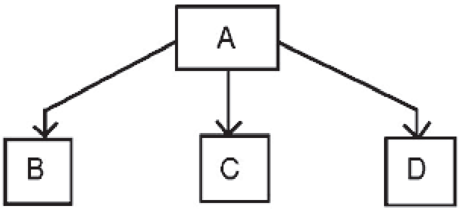

Fig. 19.4: Hierarchical Inheritance

(v) Hybrid inheritance: It is a combination of two or more types of inheritance.

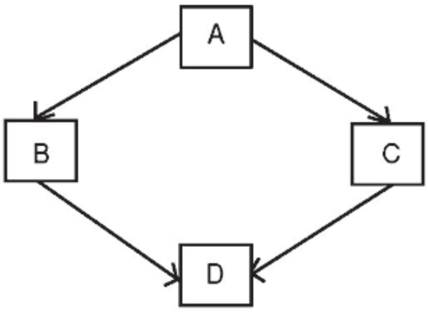

Fig. 19.5: Hybrid Inheritance

19.3 DERIVED CLASS

A derived class is defined by specifying its relationship with the base class using visibility mode.

The general form of defining a derived class is:

```
class derived_class : visibility_mode base_class
{
________________________
// members of derived class.
};
```

The colon indicates that the derived_class is derived (inherits some property) from base_class.

The base class(es) name(s) follow(s) the colon (:). The names of all the base classes of a derived class follow : (colon) and are separated by comma. The visibility-mode can be either private or public or protected. If no visibility mode is specified, then by default the visibility mode is considered as private.

Notes

Following are some examples of derived class definitions:

```
class Marksheet : public student / / public derivation
{
    // members of derived class
};
class Marksheet : private student / / private derivation
    // members of derived class
};
class Marksheet : protected student // protected derivation
{
    // members of protected class
};
```

In the above example, Marksheet is the derived class of student base class. The visibility mode public indicates that student is a public base class. Similarly, the visibility modes private or protected indicate that student is private base class or protected base class respectively.

When we say that members of a class are inheritable, it means that the derived class can access them directly. However, the derived class has access privilege only to the non-private members of the base class. Although the private members of the base class cannot be accessed directly, yet the objects of derived class are able to access them through the non-private inherited members.

19.4 MULTIPLE INHERITANCE

As we know that a subclass inheriting from multiple base classes is known as multiple inheritance. The syntax of defining a derived class is given below:

```
class derived_classname : mode baseclass1, mode baseclass2
{
// members of derived class
};
```

Multiple inheritance allows you to combine the features of multiple base classes.

Example 1

```
class marks : public semester1, private semester2
{
// members
};
```

19.5 VISIBILITY MODES

Visibility modes can be public, private or protected. The private data of base class cannot be inherited.

(i) If inheritance is done in public mode, public members of the base class become the public members of derived class and protected members of base class become the protected members of derived class.

(ii) If inheritance is done in a private mode, public and protected members of base class become the private members of derived class.

(iii) If inheritance is done in a protected mode, public and protected members of base class become the protected members of derived class.

Following table shows the visibility of base class members.

Base class Access specifier	**Derived class**		
	public	private	protected
Public	public	private	protected
Private	not Inherited	not inherited	not inherited
Protected	Protected	Protected	Protected

Table 19.1: Inherited members visibility

The Public Visibility mode

The following example and figure illustrate the public derivation in classes.

```
class student                  // base class
{
private :
        int x;                 // base class private members
        void getdata ( );
public:
        int y;
        void putdata ( );      // base class public members
protected:
        int z;
        void check ( );        // base class protected members
};
```

```
class marks : public student           // class marks derived class
{
private :
        int a ;
        void readdata ( );
public :
        int b;
        void writedata ( );
protected  :
        int c;
void checkvalue ( );
};
```

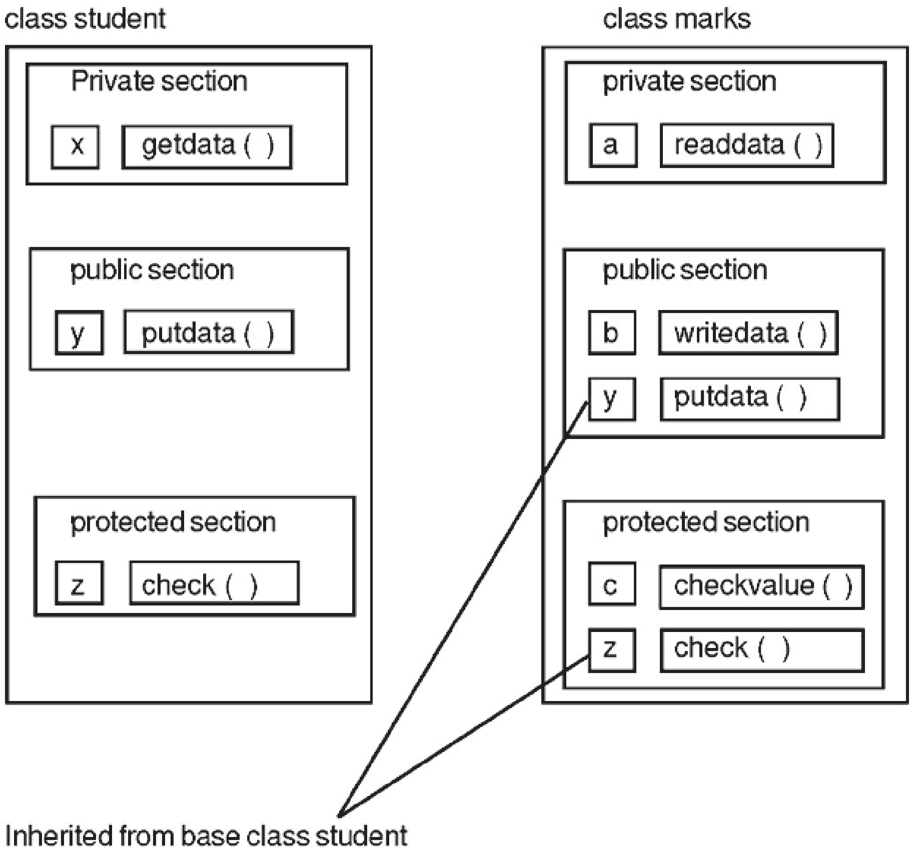

Fig. 19.6: Public derivation of a class

Notes

The public derivation does not change the access specifiers for inherited members in the derived class. The private data of base class student cannot be inherited.

The Private Visibility Mode

We are using the same example, but the derivation is done in private mode.

```
Class student
{
// same as in previous example
};
class marks : private student
{
//
};
```

The following figure illustrates the private derivation in the classes.

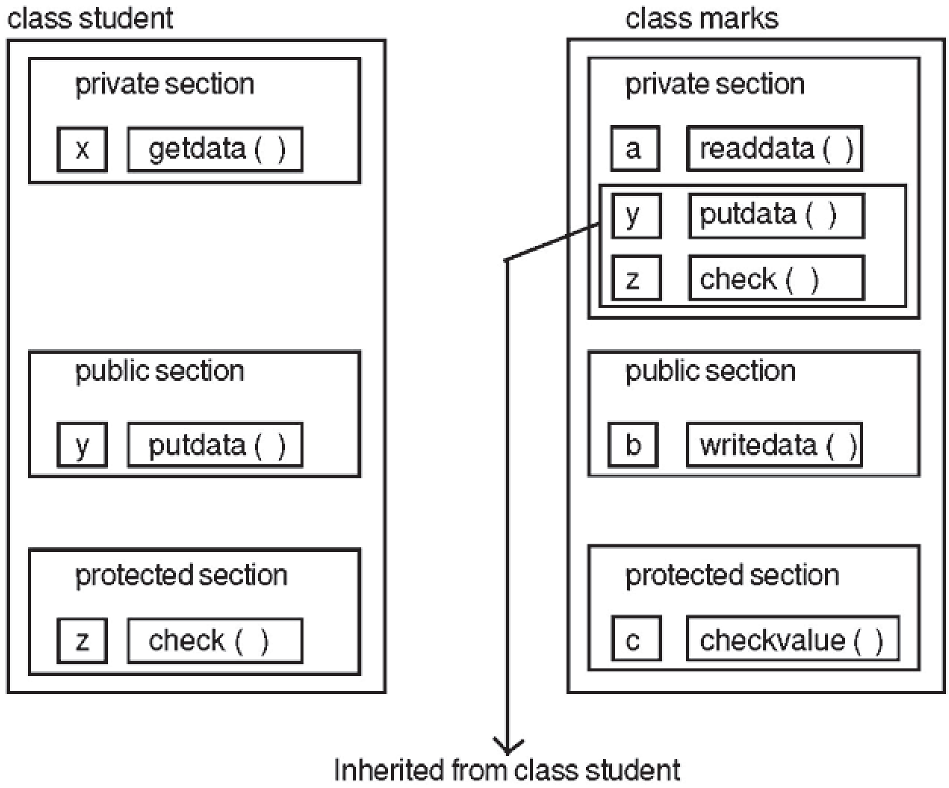

Fig. 19.7: Private derivation of a class

Notes

As it is clear from the figure that the data present in public and protected section of base class become the private members of derived class. The data in private section of base class cannot be inherited.

The Protected visibility mode

We are using the same example but the derivation is done in protected mode.

```
class student
{
// same as in previous example
};
class marks : protected student {
};
```

A member declared as protected is accessible by the member functions of the class and its derived classes. It cannot be accessed by the member functions other than these classes.

The following figure illustrates the protected derivation in the classes.

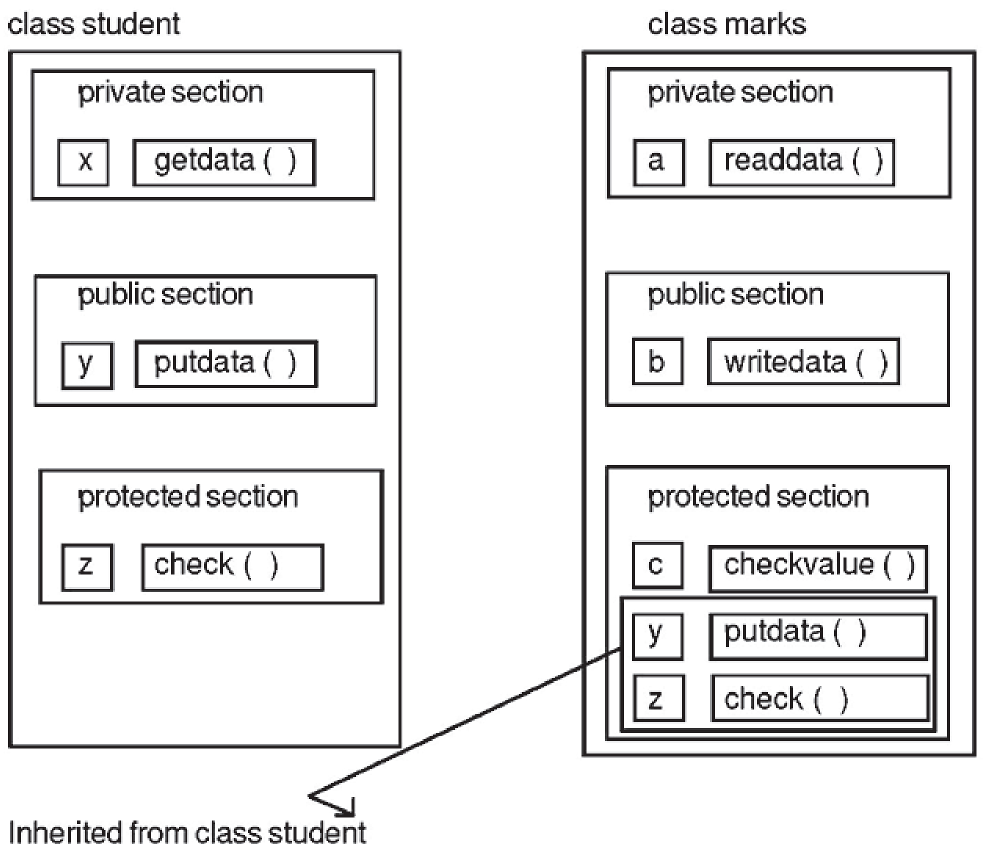

Fig. 19.8: Protected derivation of a class

The data present in private section of base class cannot be inherited. The difference between private and protected section is that data present in protected section can be inherited. Otherwise both the section cannot be accessed by the object of the class.

19.6 ABSTRACT CLASS

An abstract class is one that is not used to create objects. An abstract class is designed only to act as a base class (to be inherited by other classes). It is a design concept in program development and provides a base upon which other classes may be built. In the previous example, the class student is an abstract class since it was not used to create any object.

19.7 VIRTUAL BASE CLASS

Consider a situation where all the three kinds of inheritance, namely, multilevel, multiple and hierarchical instances are involved. Consider the following example illustrated in a figure.

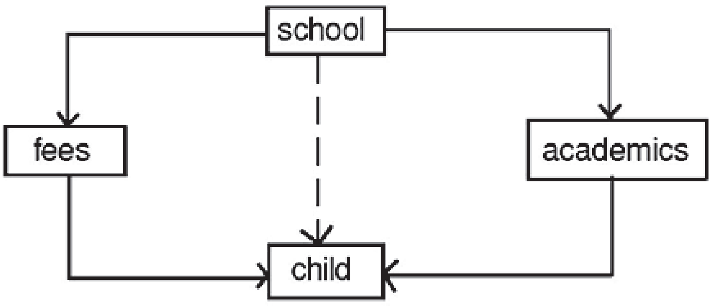

Fig. 19.9: Virtual base class

The child has two direct base classes fees and academics which themselves have a common base class ‘school’. The child inherits the traits of ‘school’ via two separate paths. It can also inherit directly as shown by the broken line. The ‘school’ is sometimes referred to as indirect base class. All the public and protected members of ‘school’ are inherited into ‘child’ twice, first via ‘fees’ and again via ‘academics’. This means, ‘child’ would have duplicate sets of the members inherited from ‘school’. This introduces ambiguity and should be avoided.

The duplication of inherited members due to these multiple paths can be avoided by making the common base class as virtual class by declaring the base class

as shown in the following example.

```
class school
{       ..............................
        ..............................
};
class fees : virtual public school
{ ..............................
..............................
};
class academics : virtual public school
{ ..............................
..............................
};
class child : public fees, public academics
{
/ / only one copy of school will be inherited.
};
```

Note : you can write either virtual public or public virtual.

INTEXT QUESTIONS 19.1

1. Fill in the blanks:
   (a) The derived class can be derived from base class in ...., ..., ... modes.
   (b) By default base class is visible as .... mode in derived class.
   (c) When a derived class is derived from more than one base class then the inheritance is called .... inheritance.
2. State whether the following statements are true or false.
   (a) Inheritance means child receiving certain traits from parents.
   (b) The default base class is visible as public mode in derived class.
   (c) When a derived class is derived from more than one base class then the inheritance is called hierarchical inheritance.
   (d) Abstract class is a base class.
   (e) Private data of base class can be inherited.

3. Consider the following class declaration and answer the questions given below:

```
class zoo
{
        char location [20];
        protected;
                int no_of_animals;
public;
        void inputdata (char, int);
        void outputdata ( );
};
class animal : protected zoo
{
        int tail;
        protected;
                int legs;
public:
        void readdata (int, int) ;
        void writedata ( );
};
class carnivorous : private animal
{
        int paw_size;
        public :
                void fetchdata (int);
                void displayed ( ) ;
};
```

(a) Name the base class and derived class of the class animal.

(b) Name the data member(s) that can be accessed from function displayed ( ).

(c) Name the data member(s) that can be accessed by an object of carnivorous class.

(d) Is the member function outputdata accessible to the objects of animal class ?

WHAT YOU HAVE LEARNT

- The process of creating a new class i.e., derived class from an existing class is called as inheritance.
- There are five types of inheritance: single inheritance, multiple inheritance, multilevel inheritance, hybrid inheritance, hierarchical inheritance.
- A derived class with only one base class is called as single inheritance.
- A derived class with several base classes is called as multiple inheritance.
- Multilevel inheritance: The mechanism of deriving a class from another derived class is called multilevel inheritance.
- Hierarchical inheritance: One class may be inherited by more than one class. This process is known as hierarchical inheritance.
- Hybrid inheritance: It is a combination of two or more types of inheritance.
- The private data of base class cannot be inherited.
- An abstract class is one that is not used to create objects. An abstract class is designed only to act as a base class.
- Virtual base classes are used for preventing multiple "instances" of a given class appearing in an inheritance.

TERMINAL EXERCISE

1 What are the needs of inheritance?

2 What are the three modes of inheritance? Explain.

3 What is a virtual base class? Explain it by taking an example.

4 Consider the following class declaration and answer the questions given below:

```
class vehicle
{
        int wheels;
        protected;
                int passenger;
```

```
public:
          void inputdata (int, int);
          void outputdata ( );
};
class heavy_vehicle: protected vehicle
{
          int diesel_petrol;
          protected:
                    int load;
public:
          void readdata (int, int) ;
          void writedata ( );
};
class bus : private heavy_vehicle
{
          char make [20];
          public :
                    void fetchdata (int);
                    void displaydata ( ) ;
};
```

(i) Name the base class and derived class of the class heavy_vehicle.

(ii) Name the data member(s) that can be accessed from function displaydata.

(iii) Name the data member(s) that can be accessed by an object of bus class.

(iv) Is the member function outputdata accessible to the objects of heavy_vehicle class?

ANSWERS TO INTEXT QUESTIONS

19.1

1. (a) public, private, protected (b) private

   (c) multiple

2. (a) True

   (b) False

   (c) False

   (d) True

   (e) False

3. (a) base class - zoo derived class - carnivorous

   (b) legs, no-of-animals, paw_size

   (c) None

   (d) No

Notes

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20

POINTER

In the previous lesson you have learnt about inheritance, types of inheritance. Now you will learn pointers, which is more powerful and is used extensively in C++ programming langauge. It saves the processing time. Pointer is a variable which holds the address of another variable. So, programming is concerned with the address, not with the direct value stored. In this lesson you will learn about pointer, pointer to array, pointer to string constant, pointer to structure, pointer to objects and this pointer.

OBJECTIVES

After reading this lesson, you will be able to:

- define pointer;
- use pointers in arrays;
- define pointer variables in a structure;
- access data members of structure through pointer;
- define pointer objects in a class and access members through pointer.

20.1 POINTER

A pointer is a variable that represents the location (rather than the value) of a data item such as a variable or an array element. Pointers are used frequently in C++, as they have a number of useful applications.

Consider the following example:

```
# include < iostream.h >
void main ( )
{
int A = 5;
cout << &A;
int *ptr;
ptr = &A;
cout << *ptr;
}
```

ptr is a pointer variable which holds the memory address of the integer variable A. ptr = &A

If variable A in the above example has a value 5, then &A holds the address of memory cell A. The variable which holds the address is called pointer variable. int *ptr means that a variable ptr is a pointer to a memory cell which can hold the int data type. *ptr is used for the value stored in a memory cell pointed to by the pointer ptr. It is called de-referencing the pointer. The output of the above program is the address of memory cell A and value 5.

```
void *ptr;
```

Here ptr can point to any data type.

20.1.1 Pointer to Array

Consider the following declaration:

```
int A [ 5 ];
```

The name of the array A itself is a pointer which holds the address of zero location (&A[0]). It is a constant in a program, its value cannot be changed. The following program prints all the values of an array A.

```
# include < iostream.h >

void main ( )

{

int A [5] = { 20, 35, 25, 22, 27 };

for (int i = 0; i < 5; i + + )

cout << "\n" << A [ i ];

}
```

The output of the above program is

The above program can be written using pointer notation also.

```
# include < iostream.h >
void main ( )
{
int A [5] = { 20, 35, 25, 22, 27 }
for (int i = 0; i < 5; i + + )
cout << "\n" << *(A + i);
}
```

At one stage the value of i is 2. Therefore A + i is two locations away from the zero location. The *(A+i) will print the data stored at that location. In the same way the statement cout <<"\n"<<*(A+i); will print the value of A[0], A[1], A[2], A[3], and A[4].

20.1.2 Pointer to String constant

Consider the following example:

```
# include < iostream.h >
void main ( )
{
char stu1 [ ] = "work as an array";
char *stu2 = "work as a pointer";
cout << stu1;                //display work as an array
cout << stu2;                // display work as a pointer
stu1 ++;                     // wrong statement
stu2 ++;
        cout << stu2;
        // it prints "ork as a pointer"
        }
```

Stu2 is a character pointer variable for a string "work as a pointer". stu2++ will increment the value of stu2 by 1. Now stu2 will have only the value of "ork as a pointer".

Notes

stu 1 + + is a wrong statement because stu1 is a pointer which holds the address of zero location (& stu1[0]). It is a constant in a program.

20.1.3 Pointer to Structure

Consider the following program

```
struct student
{
        char name [30];
        int rn;
};
```

The statement

```
student st;
```

declares st as the variable of the structure student.

The statement

```
student *ptr;
```

declares a pointer variable ptr to a student.

That data members using ptr can be referred to as

```
ptr -> name;
ptr -> rn;
```

Another way of referring the data member is

```
(*ptr) . name;
(*ptr) . rn;
```

20.1.4 Pointer to Objects

Object pointers are useful in creating objects at run time. Object pointers can be used to access the public members of an object. Consider a class student defined as follows:

```
class student
{
        char name [20];
        int rn;
        public :
                int marks;
                void getdata ( );
                void putdata ( );
};
```

```
void student : : getdata ( )
{
        cin >> name;
        cin >> rn;
        cin >> marks;
}
void student : : putdata (   )
{
        cout << “Name” << name << “\n”;
        cout << “Roll no” << rn << “\n”;
        cout << “Marks” << marks << “\n”;
}
```

Declare an object st and pointer ptr as follows:

```
        student st;
        student *ptr;
```

We can refer to the member functions and data member of student in two ways.

(i) using dot operator

```
        st. marks = 90;
        st. getdata ( );
```

(ii) using arrow operator and object pointer

```
        ptr -> marks = 90;
        ptr -> getdata ( );
```

another way to represent is (*ptr)

```
        (*ptr) . marks = 90;
        (*ptr) . getdata ( );
```

20.2 THIS POINTER

C++ uses a unique keyword called **this** to represent the object that invokes a member function. *This* is a pointer that points to the object for which *this* function was called. For example;

```
class ABC
{
int rn;
```

```
public:
        void getdata ( )
        {
        cin >> this -> rn;
        }
        void putdata ( )
        {
        cout << this -> rn;
        };
void main ( )
        {
        ABC A, B;
        A . getdata (  );
        A . putdata (  );
        B . getdata (  );
        B . putdata (  );
        }
```

When a getdata ( ) or putdata ( ) function is called through object A, *this* has the address of object A. Similarly, when a getdata ( ) or putdata ( ) function is called through object B, *this* has the address of object B.

INTEXT QUESTIONS 20.1

I. Choose the appropriate answer.

1. A pointer is ....

   (i) the address of a variable

   (ii) an indication of the variable to be accessed next

   (iii) a variable for string addresses

   (iv) the data type of address variable

2. The expression *ptr can be said to ....
   - (i) be a pointer to ptr
   - (ii) refer to the contents of ptr
   - (iii) refer to the value of the variable pointed to by ptr
   - (iv) dereference ptr

3. The expression int* can be said to ....
   - (i) be a pointer pointing to variable int
   - (ii) refer to contents of int
   - (iii) be a pointer to an int type value.

II. Fill in the blanks:

   - (a) A pointer variable stores the .... of another variable.
   - (b) The .... operator is called address operator.
   - (c) To declare t_age pointer to integer, we should write ....
   - (d) If A is an integer variable then .... gives its address.
   - (e) If ptr is a pointer to an integer variable, the number stored in it is given by ....

III. State whether the following statements are true or false:

   - (a) A pointer is an address of the variable.
   - (b) Dereferencing operator (*) is a unary operator. It is different from the multiplication operator (*) which needs two operands.
   - (c) This pointer points to the objects that is currently used to invoke a function.

WHAT YOU HAVE LEARNT

- Pointer is a variable that represents the location (rather than the value) of a data item such as a variable or an array element.
- Object pointers are useful in creating objects at run time.
- Object pointers can be used to access the public members of an object.
- C++ uses a unique keyword called **this** to represent the object that invokes a member function.

TERMINAL EXERCISE

1. If arr is an array of integers, why is the expression arr++ not legal?
2. What is the difference between arr [4] and *(arr+4)?
3. If a structure defined has pointer variable, how can it access the members of the structure ? Explain it by taking an example.
4. How can a data member and member function present in public mode in class be accessed through pointer object? Explain it by taking an example.
5. What is this pointer? Explain briefly.

ANSWERS TO INTEXT QUESTIONS

20.1

I.

1. (i) the address of a variable.
2. (iv) dereference ptr.
3. (iii) be a pointer to an int type value.

II. (a) address

(b) &

(c) int *t_age;

(d) &A

(e) *ptr

III. (a) True

(b) True

(c) True

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21

FILES

In the previous lesson you have learnt about pointers. Now, you will learn about files. In some application program, sometimes it is required to store data on hard disk or any other storage devices. The data is stored in these devices using the concept of file. In this lesson you will learn to store data in a file, access data from a file, move pointer within the file.

OBJECTIVES

After reading this lesson, you will be able to:

- store data in a file;
- access data record by record from the file;
- move pointer within the file;
- open or close file.

21.1 FILE

A file is a collection of logically related records. A program usually requires two types of data communication, (i) writing data on datafile, (ii) reading data from datafile.

Let us learn about them.

(i) Writing data on the datafile:

The data flows from keyboard to memory and from memory to storage device.

i.e., keyboard → memory → hard disk/ storage device

This is called output stream where stream is the flow of data and requires an **ofstream.h** header file.

Notes

(ii) **Reading data from datafile:**

The data flows from storage device to memory and from memory to output device, particularly monitor.

i.e., datafile → memory → output device (screen) or external storage device (hard disk/storage device)

This is called input stream and requires **ifstream**.h header file. If both input stream and output stream are used in the same program then header file **fstream.h** is required. If header file fstream.h is included in the program, there is no need to include iostream.h explicitly.

File has to be opened, before reading data from datafile or writing data on the datafile. Let us learn how to open a file.

21.1.1 Opening a file

A file can be opened in two ways:

(i) using constructor function of a class.

(ii) using the member function open ( ) of the class.

Opening a file using constructor function

The following statement opens the file STU.DAT in output mode, i.e., for writing data on the file.

```
ofstream outfile (“STU.DAT”);
```

ofstream is a class available in the compiler file. outfile is any user defined object.

The statements

```
outfile < < “TOTAL MARKS” << “\n”;
outfile < < total << “\n”;
```

are used for writing data on the file. The newline character is used for moving the pointer to the next line.

Similarly, the following statement

```
ifstream infile (“STU.DAT”);
```

opens the file “STU.DAT” in input mode, i.e., for reading purpose

The statements

```
infile >> string;
infile >> number;
```

read the data from the data file.

The following program uses a single file for both writing and reading purposes. First, it takes the data from the keyboard and writes it to the file. After the writing is completed, the file is closed. The program again opens the same file, reads the information already written to it and displays it on the screen.

```
# include < fstream.h >
void main (  )
    {
    char name [30];
    int rn, marks;
    ofstream outfile ( “INF.DAT”, ios : : binary);
    cout << “Enter student name”;
    cin >> name;
    cout << “Enter student roll number”;
    cin >> rn;
    cout << “Enter student marks”;
    cin >> marks;
    outfile << name << “\n”;
    outfile << rn << “\n”;
    outfile << marks << “\n”;
    outfile . close (   );
    ifstream infile ( “INF” );
    infile >> name;
    infile >> rn; infile >> marks;
    cout << “Name” << name << “\n”;
    cout << “Roll no” << rn << “\n”;
    cout << “Marks” << marks << “\n”;
    infile.close ( );
    }
```

The output of the program would be:

```
Enter student Name                PARAM
Enter student roll number         20
Enter student marks               90

Name                              PARAM
Roll no                           20
Marks                             90
```

Opening a file using open ( ) function

The function open ( ) can be used to open multiple files that use the same stream object.

First a stream object is assigned to and then it is used to open the file in turn.

```
filestream_class stream_object;
stream_object . open ("filename");
```

For example :

```
ofstream outfile;
outfile . open ("ABC");
– – – – –
outfile . close ( );
outfile . open ("XYZ");
– – – –
outfile.close ( );
```

Another form of open() is also available.

The open ( ) function has two parameters : filename and access mode. The general format is:

```
stream_object . open ("filename", access mode);
```

The second argument specifies the mode in which the file is opened. The default values are taken for ifstream or ofstream functions (the mode is not defined explicitly).

ios : : in for ifstream functions

ios : : out for ofstream functions

The file mode parameters can take one or more of the constants defined in the class ios.

The following table shows the file mode parameters.

Table 21.1: File mode parameters and its meaning

Parameter	Meaning
ios : : app	It opens the file in output mode. The file pointer is at the end of file and it can add a record.
ios :: ate	The file pointer is at the end of the file and it allows to add data or to modify the existing data anywhere in the file.
ios :: binary	Binary file
ios :: in	It opens the file in input mode. The file pointer is at the top of the file and it is ready for reading.
ios :: nocreate	If file is already present, it opens the file otherwise open fails.
ios :: noreplace	If file is not present, it opens the file otherwise open statement fails.
ios :: out	It opens the file in output mode. The file pointer is at the end of the file. If it already has a data, the output mode erases the content of the file.
ios :: trunc	It deletes the contents of the file if exist.

The mode can combine two or more parameters using bitwise OR operator.

Example:

outfile . open (“ABC.DAT”, ios::in | ios::out | ios :: binary);

21.1.2 Write ( ) and read ( ) functions

The functions write ( ) and read ( ) have two parameters: address of the variable, size of the variable. The address of the variable must be cast to the type char*. The general format is:

infile . read ((char*) & v, sizeof v);

outfile . write ((char*) & v, sizeof v);

where v is the variable.

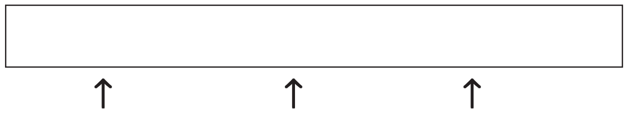
21.1.3 File Pointers

File has two associated pointers called input pointer (or get pointer) and output pointer (or put pointer). Each time an input or output operation takes place, the pointer moves automatically. There are two pointers.

seekg ( ) It moves get pointer to a specified location.

seekp ( ) It moves the put pointer to a specified location.

A file can be viewed as



ios :: beg   ios :: cur   ios :: end

ios :: beg	– means beginning of the file.
ios :: cur	– means current position of the pointer
ios :: end	– means end of the file

The seekg ( ) and seekp ( ) statement has two parameters.

object . seekg (no. of bytes, refposition);

object . seekp (no. of bytes, refpostion);

The refposition takes one of the above three constants defined in the ios class.

Example 1

infile.seekg (0, ios::beg);

It moves the pointer to the beginning of the file. In this case, the refposition ios :: beg is optional.

infile.seekg (100, ios::cur);

It moves the pointer 100 bytes forward from the current position.

infile.seekg (-200, ios::end);

It moves the pointer 200 bytes backward from the end of the file.

21.1.4 The tellg ( ) and tellp ( ) function

The tellg ( ) function gives the position of get pointer in terms of number of bytes. Similarly, tellp ( ) function gives the position of put pointer in terms of bytes.

Notes

Example 2

```
ifstream infile;
infile . open ( "ABC", ios ::ate);
int B = infile . tellg ( );
```

On execution of the above statements, the input pointer is moved to the end of the file and B gives the number of bytes in the file.

21.1.5 Close ( ) function

The file should be closed at the end if it is opened either through constructor or open ( ) function. The General format is stream_object.close ( );

The following example works with class object and does the following operations:

- Create a data file
- Display a data file
- Adding a new record
- Modify the existing record

Example 3

```
# include <fstream.h>
class student
{
        char name [30];
        int rn;
public:
        void getdata ( );
        void putdata ( );
};
void student : : getdata ( )
{
        cout <<"Enter student name";
        cin >> name;
        cout << "Enter roll number";
        cin >> rn;
}
```

```
void student :: putdata ( )
{
        cout << “Student name” << name << “\n”;
        cout << “Student roll number” << rn << “\n”;
}
void main ( )
{
        fstream file;
        file . open ( “ABC”, ios::in | ios::out | ios::binary);
        student st;
        int i, n;
        cout << “How many records to enter”;
        cin >> n;
        for (i = 1; i < = n, i ++ )
        {
        st. getdata ( );
        file . write ((char*) & st, sizeof st);
        }
        / / Display a data file
        file . seekg ( 0, ios::beg);
        while (file . read ((char*) & st, sizeof st))
        {
        st. putdata ( );
        }
        file . clear ( ); / / To make the end of file mark false
        // To append record
        st . getdata ( );
        file . write ((char*) & st, sizeof st);
        // To modify a record
        file.clear ( );
        cout << “Enter record number”;
        cin >> n;
        file . seekp ((n - 1)* sizeof st, ios::beg);
        st. getdata ( );
        file.write ((char*) & st, sizeof st);
        // To close a file
        file . close ( );
}
```

INTEXT QUESTIONS 21.1

1. Fill in the blanks:

   (a) A .... is a collection of logically related records.

   (b) The file opened in ofstream is only available for ....

   (c) The file opened in ifstream is only available for ....

   (d) We can open the file using .... function.

   (e) The mode app opens the file for ....

   (f) The file open in output mode is .... by default.

2. State whether the following statements are true or false:

   (a) A file is a collection of records.

   (b) The file opened in ofstream is available for writing.

   (c) The output mode of opening a file deletes the contents, if present in the file.

   (d) The close ( ) function is used to close a file.

   (e) The statement

   outfile.write ((char*) & obj, sizeof obj);

   writes only data in obj to outfile.

   (f) The ios::ate mode allows us to write data at the end of the file only.

   (g) We can add data to an existing file by opening in append mode.

   (h) The data written to a file with write ( ) function can be read with the get ( ) function.

WHAT YOU HAVE LEARNT

- File is a collection of logically related records.
- You can write data on the file and read data on the file.
- A file can be opened in two ways: (i) using constructor function of a class, (ii) using the member function open() of the class.

Notes

- Open( ) requires two parameters: file name and access mode.
- File has two pointers called input pointer and output pointer.
- Tellg( ) function gives the position of get pointer in terms of number of bytes.
- Tellp( ) function gives the position of put pointer in terms of bytes.

TERMINAL EXERCISE

1. What is an input stream?
2. What is the difference between opening a file with constructor function and opening a file with open () function?
3. What is the file access mode? Describe the various file modes.
4. A file consists of 5 records, each takes 100 bytes of storage:

   fstream file:

   file. seekg (0, ios::end);

   N = file.tellg ( );

   (i) What will be the datatype of N?

   (ii) What will be the value of N?
5. Consider the following statements:

   fstream file;

   file.open (“ABC”, ios::in | ios::out);

   Write C++ statement(s) for the following:

   (i) To move the pointer at the beginning of file.

   (ii) To move the pointer at the end of file.

   (iii) To find the total number of bytes.

   (iv) To close the file.
6. Explain the functioning of the following:

   fstream file;

   (i) file.seekg (100, ios::cur);

   (ii) file.seekg (-100, ios::end);

   (iii) file.seekg (100, ios::beg);

7. The record consists of two fields: name and rollno. Write a program that will perform the following:

   (i) create a data file of 5 records

   (ii) display a data file

   (iii) append a record

   (iv) modify one of the records

ANSWERS TO INTEXT QUESTIONS

21.1

1. (a) file (b) output

   (c) input (d) open

   (e) output (f) trunc

2. (a) True (b) True

   (c) True (d) True

   (e) True (f) False

   (g) True (h) False

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22

FUNDAMENTALS OF DATA STRUCTURE

In the previous module you have learnt about C++ programming. Now you will learn about the fundamentals of data structure. Each organisation, regardless of its size or purpose, generates data to keep a record of events and transactions that take place within the business. Generating and organising this data in a useful way is called data processing. In this lesson, you will learn about various terms such as data, information, data processing and data processing system.

OBJECTIVES

After reading this lesson, you will be able to:

- define the concepts of data, information and data processing;
- explain various data processing activities;
- utilise data processing cycle;
- explain data elements, records, files and databases.

22.1 DATA

The word "data" is the plural of datum, which means fact, observation, assumption or occurrence. More precisely, data are representations of facts pertaining to people, things, ideas and events. Data are represented by symbols such as letters of the alphabets, numerals or other special symbols.

22.2 DATA PROCESSING

Data processing is the act of handling or manipulating data in some fashion. Regardless of the activities involved in it, processing tries to assign meaning to data. Thus, the ultimate goal of processing is to transform data into information.

Data processing is the process through which facts and figures are collected, assigned meaning, communicated to others and retained for future use. Hence we can define data processing as a series of actions or operations that converts data into useful information. We use the term 'data processing system' to include the resources that are used to accomplish the processing of data.

22.3 INFORMATION

Information, thus can be defined as "data that has been transformed into a meaningful and useful form for specific purposes". In some cases data may not require any processing before constituting information. However, generally, data is not useful unless it is subjected to a process through which it is manipulated and organised, its **content is analyzed** and **evaluated**. Only then data becomes information.

There is no hard and fast rule for determining when data becomes information. A set of letters and numbers may be meaningful to one person, but may have no meaning to another. Information is identified and defined by its users.

For example, when you purchase something in a departmental store, a number of data items are put together, such as your name, address articles you bought, the number of items purchased, the price, the tax and the amount you paid. Separately, these are all data items but if you put these items together, they represent information about a business transaction.

22.4 DATA PROCESSING ACTIVITIES

As discussed above, data processing consists of those activities which are necessary to transform data into information. Computer is not the only tool used for data processing; it can be done without computers also. However, computers have outperformed people for certain tasks. There are some other tasks for which computer are a poor substitute for human skill and intelligence.

Regardless to the type of equipment used, various functions and activities which need to be performed for data processing can be grouped under five basic categories as shown in Fig. 22.1.

Collection	**Conversion**	**Manipulation**	**Storage**	**Communication**
Originating	Coding	Sorting	Storing	and
Measuring	Classifying	Calculating	Retrieving	Reproduction
Recording	Verifying	Summarizing		
Comparing	Transforming	Comparing		

Fig. 22.1: Data Processing Activities

We will now describe each of these activities:

Deptt. 5 Employee Time Sheet for Week ending 21/07/2001							
Hours Worked							
Emp No.	**Name**	**Mon**	**Tues**	**Wed**	**Thurs**	**Fri**	**Total Hours**
110	Hariom	8	8	8	8	8	40
150	Dinesh	8	8	8	8	6	38
160	Rajesh	8	4	8	8	8	36
170	Pankaj	8	6	8	5	8	35

Fig. 22.2: The source document for a payroll application is the weekly time sheet

(a) Collection

Data originates in the form of events transaction or some observations. This data is then recorded in some usable form. Data may be initially recorded on paper source documents 22.2 and then converted into a machine usable form for processing. Alternatively, it may be recorded by a direct input device in a paperless, machine-readable form. Data collection is also termed as **data capture**.

(b) Conversion

Once the data is collected, it is converted from its source documents to a form that is more suitable for processing. The data is first codified by assigning identification codes. A code comprises of numbers, letters, special characters, or a combination of these. For example, an employee may be allotted a code as 52-53-162, his category as A class, etc. It is useful to codify data, when data requires classification. To classify means to categorize, i.e., data with similar characteristics are placed in similar categories or groups. For example, one may like to arrange accounts data according to account number or date. Hence a balance sheet can easily be prepared.

After classification of data, it is verified or checked to ensure the accuracy before processing starts. After verification, the data is transcribed from one data medium to another. For example, in case data processing is done using a computer, the data may be transformed from source documents to machine sensible form using magnetic tape or a disk.

(c) Manipulation

Once data is collected and converted, it is ready for the manipulation function which converts data into information. Manipulation consists of the activities like sorting, calculating, summarizing and comparing.

Sorting

It involves the arrangement of data items in a desired sequence. Usually, it is easier to work with data if it is arranged in a logical sequence. Most often, the data are arranged in alphabetical sequence. Sometimes sorting itself will transform data into information. For example, a simple act of sorting the names in alphabetical order gives meaning to a telephone directory. The directory will be practically worthless without sorting. Business data processing extensively utilises sorting technique. Virtually all the records in business files are maintained in some logical sequence. Numeric sorting is common in computer-based processing systems because it is usually faster than alphabetical sorting.

Calculating

Arithmetic manipulation of data is called calculating. Items of recorded data can be added to one another, subtracted, divided or multiplied to create new data as shown in Fig. 22.2(a). Calculation is an integral part of data processing. For example, in calculating an employee's pay, the hours worked multiplied by the hourly wage rate gives the gross pay. Based on total earning, income-tax deductions are computed and subtracted from gross-pay to arrive at net pay.

Weekly Payroll Summary Report 07/07/2005

Dept.	Employee Number	Name	Hours Worked	Pay Rate	Gross Wages
2	170	Pankaj	34	10.00	340.00
	175	Rekha	32	9.00	288.00
	158	Param	20	5.00	100.00
	160	Rajesh	36	8.00	288.00
	165	Sanju	45	9.00	405.00
	159	Savini	25	3.00	75.00
Department 2 Total			192		1496.00
4	110	Hari Om	33	7.75	255.75
	115	Vimla	40	9.25	370.00
Department 4 Total			73		625.75
8	150	Dinesh	38	7.00	266.00
	155	Upma	40	9.45	390.00
	156	Arunima	32	8.50	272.00
	157	Ritwik	40	8.00	320.00
Department 8 Total			150		1,248.00
Company Total			415		3,369.75

Fig. 22.2(a) : Weekly Payroll Summary

Summarizing

To summarize is to condense or reduce masses of data to a more usable and concise form as shown in Fig. 22.2(b). For example, you may summarize a lecture attended in a class by writing small notes in one or two pages. When the **data involved** is numbers, you summarize by counting or accumulating the total of the data in a classification or by selecting strategic data from the mass of data being processed. For example, the summarizing activity may provide a general manager with sales-totals by major product line, the sales manager with sales totals by individual salesman as well as by the product line and a salesman with sales data by customer as well as by product line.

Department Payroll Summary for Week of 07-07-2005		
Department	**Hours**	**Gross Wages**
2	192	1,496.00
4	73	625.75
8	150	1,248.00
Company Total	415	3,369.75

Fig. 22.2(b) : Department Payroll Summary

Comparing

To compare data is to perform an evaluation in relation to some known measure. For example, business managers compare data to discover how well their companies are doing. They compare current sales figures with those for last year to analyze the performance of the company in the current month.

(d) Managing the Output Results

Once data has been captured and manipulated following activities may be carried out :

Storing

To store is to hold data for continued or later use. Storage is essential for any organised method of processing and re-using data. The storage mechanisms for data processing systems are file cabinets in a manual system, and electronic devices such as magnetic disks/magnetic tapes in case of computer based system. The storing activity involves storing data and information in organised manner in order to facilitate the retrieval activity. Of course, data should be stored only if the value of having them in future exceeds the storage cost.

Retrieving

To retrieve means to recover or find again the stored data or information. Retrieval techniques use data storage devices. Thus data, whether in file cabinets or in computers can be recalled for further processing. Retrieval and comparison of old data gives meaning to current information.

(e) Communication

Communication is the process of sharing information. Unless the information is made available to the users who need it, it is worthless. Thus, communication involves the transfer of data and information produced by the data processing system to the prospective users of such information or to another data processing system. As a result, reports and documents are prepared and delivered to the users. In electronic data processing, results are communicated through display units or terminals.

Reproduction

To reproduce is to copy or duplicate data or information. This reproduction activity may be done by hand or by machine.

INTEXT QUESTIONS 22.1

1. Differentiate between the following :
   (a) Data and Information
   (b) Data processing and Data processing system
2. Define the following terms briefly:
   (a) Sorting
   (b) Summarizing

22.5 THE DATA PROCESSING CYCLE

The data processing activities described above are common to all data processing systems from manual to electronic systems. These activities can be grouped in four functional categories, viz., data input, data processing, data output and storage, constituting what is known as a data processing cycle.

(i) Input

The term input refers to the activities required to record data and to make it available for processing. The input can also include the steps necessary to check, verify and validate data contents.

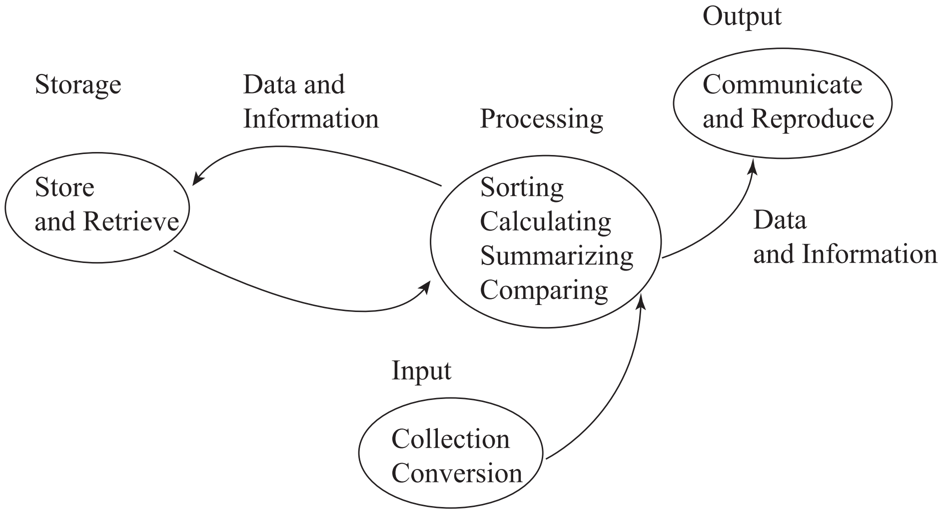

Fig. 22.3: Data Processing Cycle

(ii) Processing

The term processing denotes the actual data manipulation techniques such as classifying, sorting, calculating, summarizing, comparing, etc., that convert data into information.

(iii) Output

It is a communication function which transmits the information, generated after processing of data, to persons who need the information. Sometimes output also includes decoding activity which converts the electronically generated information into human-readable form.

(iv) Storage

It involves the filing of data and information for future use. The above mentioned four basic functions are performed in a logical sequence as shown in Fig. 22.3 in all data processing systems.

22.6 COMPUTER PROCESSING OPERATIONS

A computer can perform only the following four operations which enable computers to carry out the various data processing activities we have just discussed.

(a) Input/Output operations

A computer can accept data (input) from and supply processed data (output) to a wide range of input/output devices. These devices such as keyboards, display screens, and printers make human-machine communication possible.

(b) Calculation and text manipulation Operations

Computer circuits perform calculations on numbers. They are also capable of manipulating numerics and other symbols used in text with equal efficiency.

(c) Logic/Comparison Operations

A computer also possesses the ability to perform logic operations. For example, if we compare two items represented by the symbols A and B, there are only three possible outcomes.

A is less than B (A<B); A is equal to B (A=B); or A is greater than B (A>B). A computer can perform such comparisons and depending on the result, follow a predetermined path to complete its work. This ability to compare is an important property of computers.

(d) Storage and Retrieval Operations

Both data and program instructions are stored internally in a computer. Once they are stored in the internal memory, they can be called up quickly or retrieved, for further use.

22.7 DATA PROCESSING SYSTEM

The activity of data processing can be viewed as a "system". According to James O'brien a system can be defined as "a group of interrelated components that seeks the attainment of a common goal by accepting inputs and producing outputs in an organised process". For example, a production system accepts raw material as input and produces finished goods as output.

Similarly, a data processing system can be viewed as a system that uses data as input and processes this data to produce information as output.

INPUT → PROCESSING → OUTPUT

There are many kinds of data processing systems. A manual data processing system is one that utilizes tools like pens, and filing cabinets. A mechanical data processing system uses devices such as typewriters, calculating machines and book-keeping machines. Finally, electronic data processing uses computers to automatically process data.

22.8 DATA ORGANISATION

Having discussed the Data Processing Cycle (also called Information Processing Cycle) and the components of a computer, we will now describe how data is organised before processing on a computer. Data can be arranged in a variety of ways, but a hierarchical approach to organisation is generally recommended.

Data Item

A data item is the smallest unit of information stored in computer file. It is a single element used to represent a fact such as an employee's name, item price, etc. In a payroll application, the employee number 170 is a data item. PANKAJ, the name is a data item.

Field

Data items are physically arranged as fields in a computer file. Their length may be fixed or variable. Since all individuals have 3 digit employee numbers, a 3-digit field is required to store the particular data. Hence, it is a fixed field. In contrast, since customer's name vary considerably from one customer to another, a variable amount of space must be available to store this element. This can be called as variable field.

Record

A record is a collection of related data items or fields. Each record normally corresponds to a specific unit of information. For example, various fields in the record, illustrated in Fig. 22.4 are employee number, employee's name, basic salary and house rent allowance. This is the data used to produce the payroll register report. The first record contains all the data concerning the employee PANKAJ. The second record contains all the data concerning the employee REKHA. Each subsequent record contains all the data for a given employee. It can be seen how each related item is grouped together to form a record.

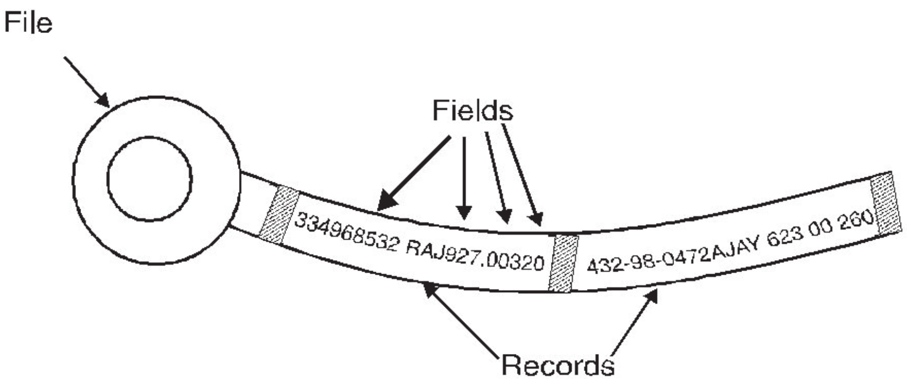

Fig. 22.4: Data Record

File

The collection of records is called a file. A file contains all the related records for an application. Therefore, the payroll file shown in Fig. 22.5 contains all records required to produce the payroll register report. Files are stored on some medium, such as magnetic disk, flash drive or CD ROM.

Database

The collection of related files is called as database. A database contains all the related files for a particular application.

22.9 VARIABLE AND FIXED LENGTH RECORDS

Records can be of fixed or variable length as depicted in Fig. 22.5.

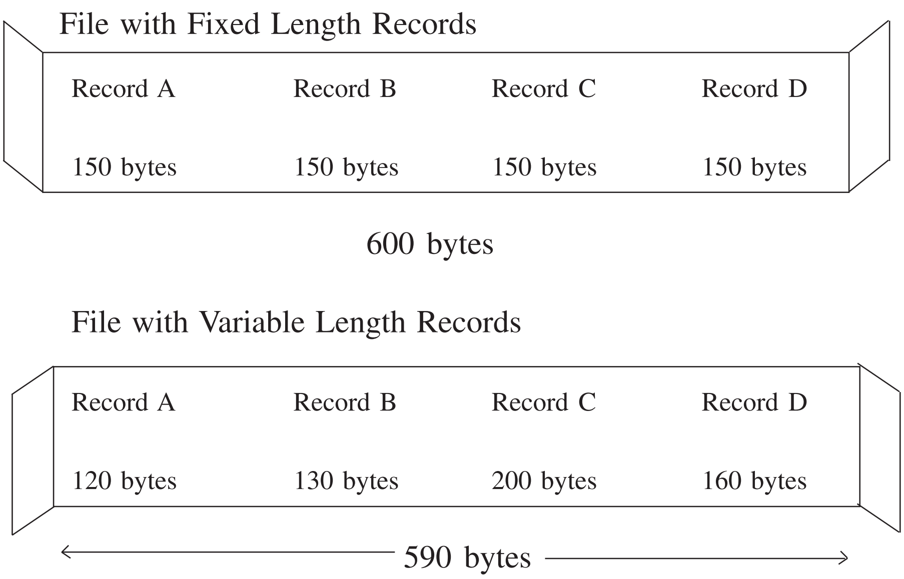

Fig. 22.5: Fixed and variable length records.

Fixed Length Records

In this case, all the records in a file have the same number of bytes. Such a file is called a **flat file**. If all the records are expected to contain essentially the same quantity of data, then fixed length records are used.

Variable Length Records

In this case, records vary in length. Use of variable length records conserves storage space when the quantity of information, of various records in a file, differs significantly.

22.10 LOGICAL VERSUS PHYSICAL RECORD

A logical record contains all the data related to a single entity. It may be a payroll record for an employee or a record of marks secured by a student in a particular examination. A physical record refers to a record whose data fields are stored physically next to one another. It is also the amount of data that is treated as a single unit by the input-output device. Portions of the same logical record may be located in different physical records or several logical records may be located in one physical record. For example, in case of magnetic tape, number of logical records are stored in the form of a block to increase the data transfer speed and this block is referred to as a physical record as shown in Fig. 22.6

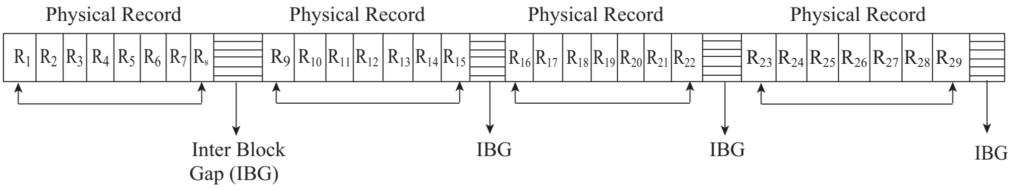

Fig. 22.6: Physical and logical Record

INTEXT QUESTIONS 22.2

1. Identify various data processing activities.
2. Define the various steps of data processing cycles.
3. State whether the following statements are true or false:
   (i) All the records in a file have the same number of bytes, are called as fixed length.
   (ii) A physical record refers to a record whose data fields are stored physically next to one another.
   (iii) Data items are physically arranged as fields in a computer file. Their length is fixed.

WHAT YOU HAVE LEARNT

- Data is a fact, observation, assumption or occurrence.
- Data processing is a series of actions or operations that converts data into useful information.

- Data that has been transformed into a meaningful and useful form for specific purposes is called as information.
- Data processing activities can be grouped as collection, conversion, manipulation, communication and reproduction.
- Data input, data processing, data output and storage constitutes data processing cycle.
- Data item is the smallest unit of information stored in computer file.
- A record is a collection of related data items or fields.
- The collection of records is called as file.
- The collection of related files is called as database.

TERMINAL EXERCISE

1. Define the terms data, data processing and information.
2. Identify various activities involved in manipulation.
3. Write down the various computer processing operations briefly.
4. How data is organised before processing on a computer starts? Discuss briefly.

ANSWERS TO INTEXT QUESTIONS

22.1

1. (a) The word "data" is the plural of datum which means fact, observation, assumption or occurrence. On the other hand, information can be defined as data that has been transformed into a meaningful and useful form for specific purposes.

   (b) Data processing is the process through which facts and figures are collected, assigned meaning, communicated further and retained for future use. It is a series of actions or operations that converts data into useful information. In data processing system, we include the resources that used to accomplish the processing of data.

2. (a) It involves the arrangement of data items in a desired sequence.

   (b) It means to condense or reduce masses of data to a more usable and concise form.

22.2

1. Data processing activities are grouped under following five basic categories.

   (i) Collection (ii) Conversion

   (iii) Manipulation (iv) Storage and retrieval

   (v) Communication

2. The various steps involved in data processing cycle are as follows:

   (i) Data input (ii) Data processing

   (iii) Output (iv) Storage

3. (i) True (ii) True

   (iii) False

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DATABASE MANAGEMENT SYSTEMS

In the previous lesson you have learnt that data processing concepts. Now you know that computers are used to process data. You can feed data into the computers and give the instructions (in the form of programs) to process the data. Computers can process the data by following the specified instructions. Computers are able to process data at extremely high speeds. There are lots and lots of data which are processed by the computers. For easy and efficient processing of data it is necessary that the data is stored in an organized way. There are specialized software, called Database Management Systems, which facilitate organized storage of data. In this lesson you will learn about Database Management Systems.

OBJECTIVES

After reading this lesson, you will be able to:

- define database;
- design simple databases;
- create databases and tables within them using MySQL;
- write and execute SQL commands to perform various database operations.

23.1 TERMINOLOGY

To understand the concepts of Database Management System, you must be familiar with a few terms which are given below:

Database: A database is an organized collection of data. From daily life we can take many examples of simple databases. A few are: An index of a book,

telephone directory, classified ads in a newspaper etc. More complex examples may include registers containing data of students in a school, data of employees in a big organization etc.

Need of computerized Database: Databases can be organized manually or using computers. When the databases are organized manually, some problems creep in frequently. These problems are:

- **Redundancy**: Having multiple copies of the same data. For example a student's name is written in office records as well as in class teacher's record. Redundancy leads to inconsistency.
- **Inconsistency**: Having multiple mismatching copies of the same data. For example if a student's section changes from A to B, this change is recorded in class teachers' registers but not in office register.
- **Loss of Integrity**: Integrity means having consistent valid data all the time. Data consistency is also a kind of data integrity. Data integrity also includes having valid data only. For example if there are four sections (A, B, C, D) of a class but a student's section is recorded as something other than these, then it is an example of loss of integrity.
- **Data Insecurity**: Manual databases can be secured physically but cannot be secured against unauthentic data alterations.

Computerized databases provide centralized control of its operational data. Thus, with the help of a computerized database:

1. Redundancy is controlled.
2. Inconsistence can be avoided.
3. Integrity of data is maintained.
4. Data can be shared.
5. Security restrictions can be applied.

Data Base Management System (DBMS): A DBMS is a software that allows us to manage computerized databases.

Relational Database Management System (RDBMS): It is a DBMS based on relational model introduced by E.F.Codd.

Relational Database: A relational database is a database in which data is organized in two-dimensional tables (also called relations). A Table consists of rows (also called tuples or records) and columns (also called attributes or fields).

The following table consists of three fields : Name, Telephone, Address; and two rows.

Name	Telephone	Address
Abhishek	555227822,	Prem Nagar.
Puneet	5438763	A-15, Mohan Nagar.

Schema – It refers to the organization of data or skeleton structure that represents the logical flow of the entire database.

Entity: An entity is a person or object (physical or logical) for which we need to store data in a database. In a school it can be a student, a teacher, a course etc. In a library an entity can be a book, a member, a book supplier etc.

Relation: A relation (or a table) is a collection of data corresponding to the same kinds of entities in a database. A relation may contain data of all the books in a library, or data of all the items in a shop etc. A database contains one or more than one relations.

Tuple/Row/Record: A tuple corresponds to a row of a relation. A tuple contains data corresponding to an entity. The number of tuples in a relation is called the **cardinality** of the relation.

Attribute: An attribute corresponds to a column in a relation. The number of attributes (columns) in a relation is called its **degree**.

Domain: A domain (of a column) is a pool of values from which that column draws its actual values. For example, domain of the column RollNumber may be integers from 1 to 50.

Key: A column or a combination of columns which can be used to identify a row (tuple) in a table is called its key. In general, any column or any combination of columns in a table is a key.

Primary Key: The group of one or more columns used to uniquely identify each row of a relation is called its Primary Key. For example, in a students table AdmissionNumber can be the primary key. A table cannot have more than one primary key.

Candidate Key: A field or combination of fields which can be used as a primary key of a relation is called a candidate key because it is one of the candidates available to be the primary key of the relation. A table may have multiple candidate keys. For example, in a students table *AdmisionNumber* as well as the combination *Class+Section+RollNumber* are the candidate keys.

Alternate Key: A table may have multiple candidate keys. One of these keys become the primary key of the table. All the remaining candidate keys are called alternate keys of the relation.

Foreign Key: A group of one or more columns in a table which is used to set relationship of this table with some other table.

Cartesian Product (of two tables): It is a new table which contains the columns of both the given tables. The rows of the new table are obtained by pairing each row of the first table with each row of the second table.

Normalization: Normalization is the process of analyzing the data to be represented and breaking it down into separate tables in accordance with the principles of relational structure.

Need for Normalization: Normalization is carried out for four reasons:

1. To structure the data
2. To permit the simple retrieval of data in response to queries or reports.
3. Simplify maintenance of data through update, delete and insert operations.
4. To reduce the need to restructure or reorganize the data when new application requirement arises.

23.2 DATA MODELS

To computerize a database, first the database has to be designed. If database is not designed properly then it definitely leads to failure of any software based on it. Proper attention must be paid to study the database to be designed. The developer should know and very well understand all the minute details of the database then only he/she can develop a good and sustainable database. For this purpose the developer has to design three models of the database – First the **Conceptual Data Model**, then the **Logical Data Model**, and then the **Physical Data Model** – in this sequence only.

To understand this concept of data models assume the simplified version of School. This school offers various courses (vocational, academic, short term, long term etc.) to its students. Due to increasing number of students and a large number of courses, it is becoming difficult for the school to manage this database (containing the data of students, courses, and results) manually. So, the school decides to hire a software consultant, say Mr. SoftCon, to computerize this database. To computerize the database Mr. SoftCon designs the conceptual data model, logical data model and physical data model.

Conceptual Data Model: Conceptual Data Model can be thought of as a bird's eye-view of the database. It identifies various entities and the highest-level relationship among them.

In our example of School, the entities are: Students, Courses, Marks, and Results. Results are prepared by taking data of students, courses, and marks. This can be displayed as follows:

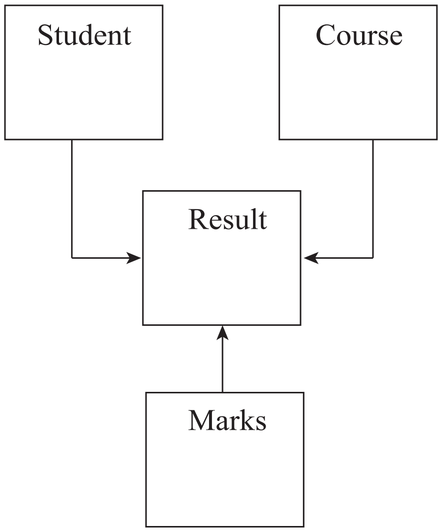


Fig. 23.1: Conceptual data model

Conceptual data model has the following features:

- It includes important entities and relationships among them.
- No attribute is specified.
- No primary key is specified.

Logical data Model: Logical data model can be thought of as a closer view of the database. In the conceptual model we look at the entities and their relationships only. In logical data model we describe the attributes of these entities in as much details as possible.

In our example of school, the entities are: Students, Courses, Marks, and Results.

In the logical data model we may consider their attributes as follows:

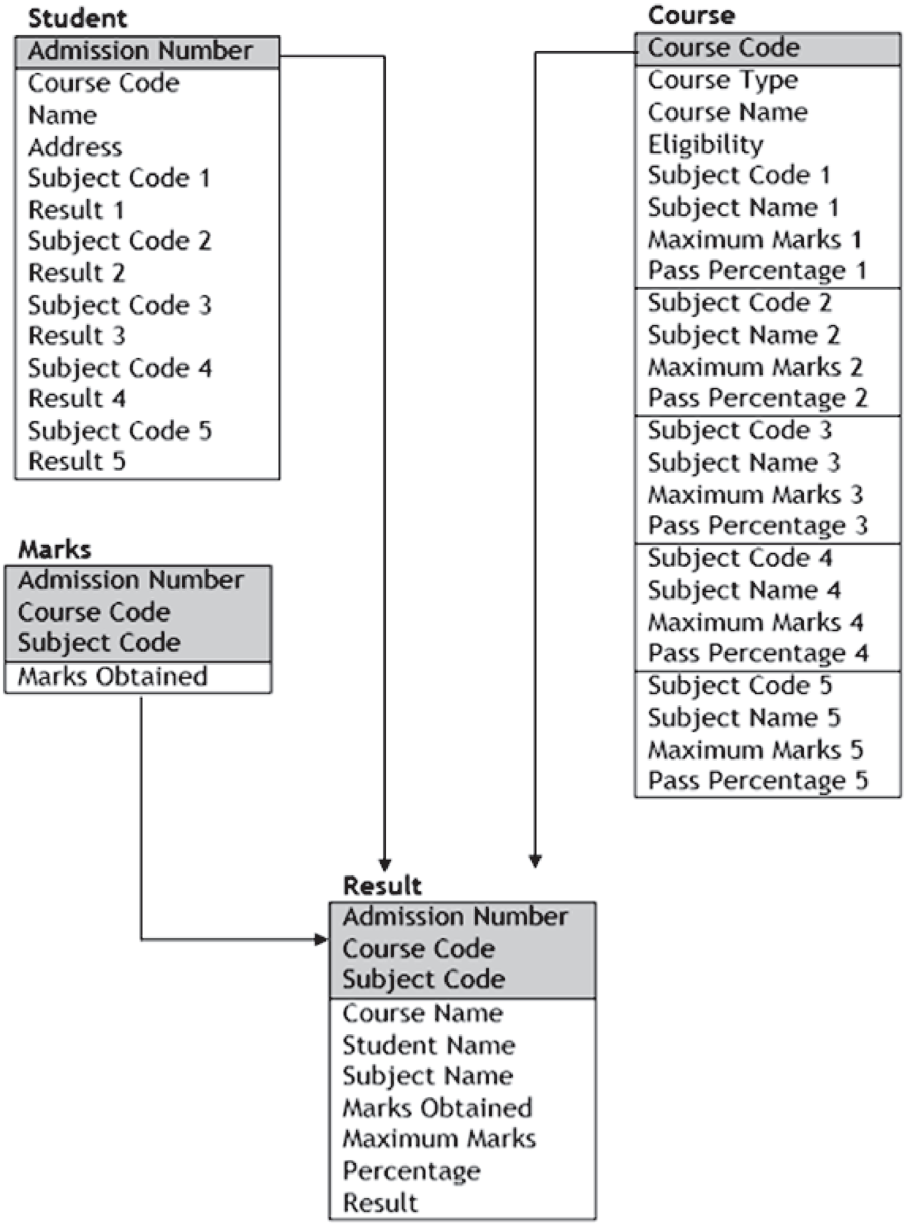


Fig. 23.2: logical data model

Foreign Keys:

Table	Foreign Key(s)
Course	None
Student	Course Code, Subject Codes
Marks	Admission Number, Course Code, Subject Code
Result	Admission Number, Course Code, Subject Code

Logical data model has the following features:

- It includes all entities and relationships among them.
- Normalization occurs at this level.
- All attributes for each entity are specified.
- The primary key for each entity is specified. In our example primary keys have been highlighted.
- Foreign keys (keys identifying the relationship between different entities) are specified.

Physical data Model: Physical data model represents the actual implementation of the Logical Data Model. A physical data model shows all the table structures including column names, column data types, column constraints, primary key, foreign key and relationship between tables.

In our example of School, the physical data model can be represented as follows:

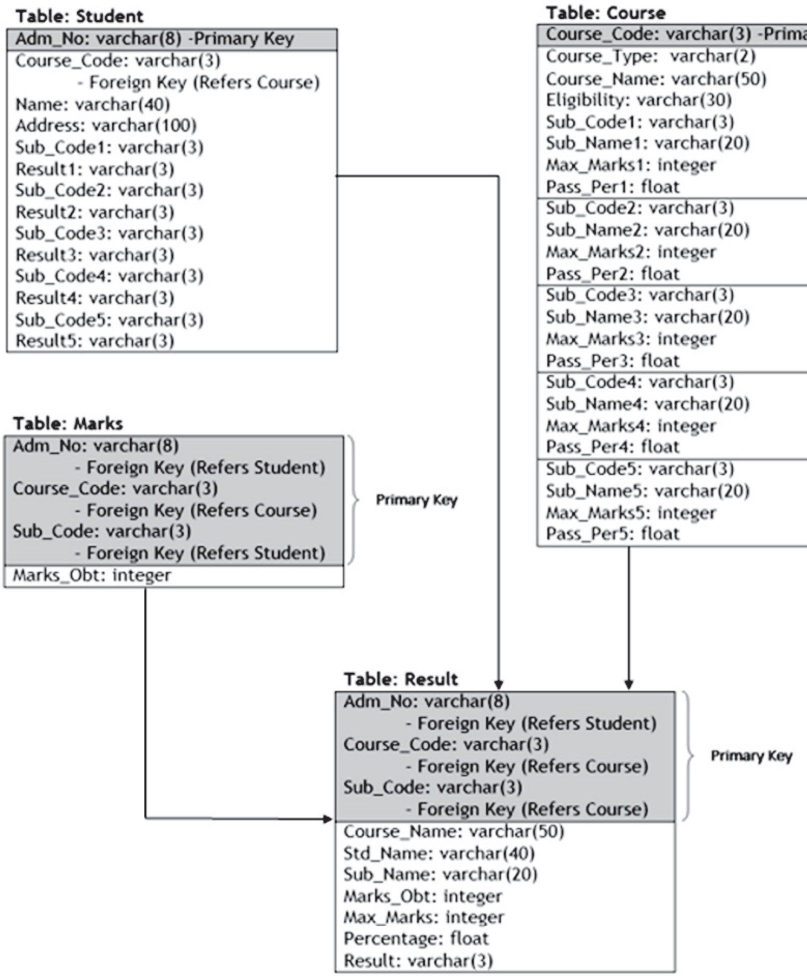


Fig. 23.3 Physical data model

INTEXT QUESTIONS 23.1

1. Fill in the blanks:

   a. A .... is an organized collection of data.

   b. Having multiple copies of the same data is called ....

   c. In a ....database the data is organized in two-dimensional tables.

   d. A .... key is a group of one or more columns in a table which is used to set relationship of a table with some other table.

2. State whether the following statements are true or false:

   a. A table can have more than one primary keys.

   b. A relation can have more than one foreign keys.

   c. By normalization we combine all the data into one big table.

   d. Conceptual data model and logical data model are the same.

   e. In the physical data model we specify the data types of the attributes.

23.3 MYSQL

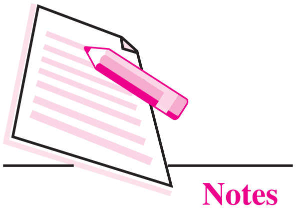
Once we have designed the physical data model, it is time to actually create the database in the computer and store data in it. To create the database we have to have some RDBMS (Relational DataBase Management System) software. There are many RDBMS software available like Oracle, MySQL, MS SQL Server, PostgreSQL etc.

MySQL is an open source free software. It can be downloaded free of cost from **http://dev.mysql.com/downloads/mysql** and requires no cost for its usage. After downloading MySQL software, you can easily install it. After installing MySQL you have to locate the file.

Most probably you will find this file in the folder (Assuming that MySQL is installed in C:\ drive)

C:\Program Files\MySQL\MySQL Server 5.1\bin

If you do not find the file here then you can search for it. Once you find it, you should create its shortcut on the desktop so that you can easily run it.



Notes

When you run this file, MySQL window will open with a prompt to provide password:

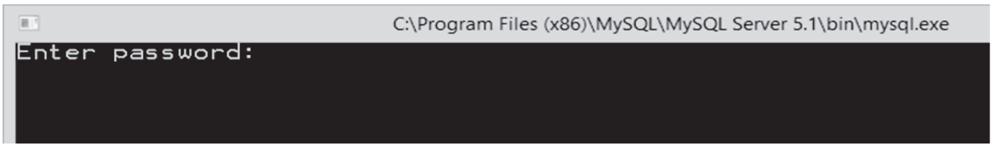


Fig. 23.4: MySQL Window

Here you should enter the same password which you entered during installation. If you enter the correct password, MySQL will welcome you with a MySQL prompt ( ) in the window:

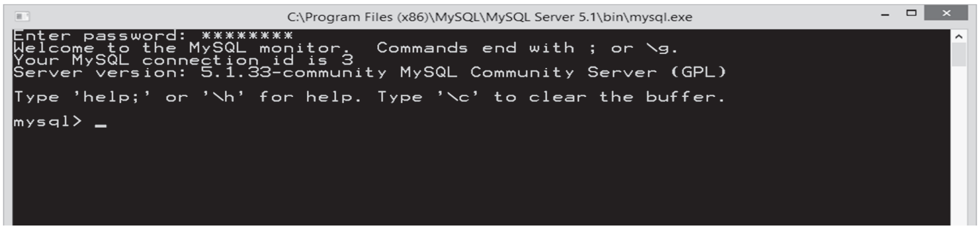


Fig. 23.5: MySQL command prompt

Now you can use MySQL to create and manage databases. To exit from MySQL you have to give the command QUIT or EXIT at the MySQL prompt.

23.3.1 Structured Query Language:

After installing MySQL you are ready to use it. Now you can create a database and tables within it. You can also enter data in the tables and manipulate this data. But the question is: How do we do this? To do all this we have to use a language called SQL (Structured Query Language).

SQL is a language specifically oriented around relational databases. It is a non-procedural language and requires us to specify what is to be done as opposed to how to do it. SQL offers us various commands using which you create and manage relational databases. These commands are classified into following classes depending on their purpose:

1. **Data Definition Language (DDL)**: It consists of those commands that create, modify, and remove objects (tables, indexes, views and so on) in the database.

2. **Data Manipulation Language (DML)**: It consists of those commands that are used to retrieve, manipulate and update the data present in tables.

3. **Data Control Language (DCL)**: It consists of those commands that determine whether a user is permitted to perform a particular action.

Before we start learning SQL, let us note few points:

- SQL is a non case-sensitive language. It means that commands can be entered using uppercase letter, lowercase letters, or a combination of these two. For SQL all these mean the same.
- Each command in SQL is terminated by a semi-colon(;).
- A statement may spread into multiple lines. It will be terminated only when a semi-colon appears.

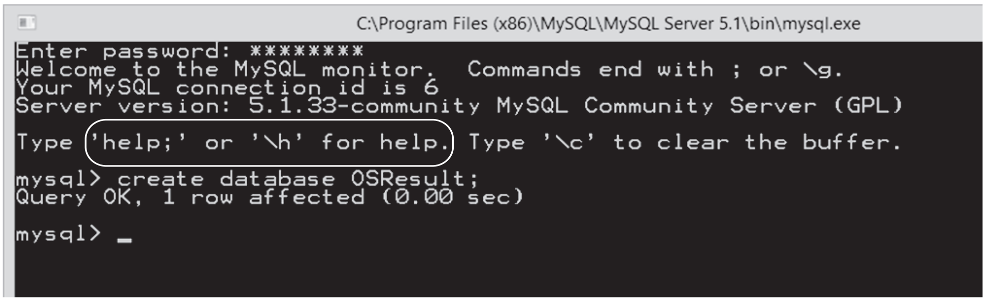
First of all we have to create the database using the SQL command CREATE DATABASE as follows:

CREATE DATABASE <DatabaseName>;

We can create multiple databases in this way. To work on any database and to switch from one database to another. We use the command: USE DB_NAME; where DB_Name is the name of the database we want to use.

Suppose you want to name the database as OSResult, then the command will be given as follows:

CREATE DATABSE OSResult;


C:\Program Files (x86)\MySQL\MySQL Server 5.1\bin\mysql.exe

```
Enter password: ********
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 6
Server version: 5.1.33-community MySQL Community Server (GPL)

Type 'help;' or '\h' for help. Type '\c' to clear the buffer.

mysql> create database OSResult;
Query OK, 1 row affected (0.00 sec)

mysql> _
```

If a given command is executed successfully then MySQL gives an OK message, otherwise it gives an error message stating why the command failed.

First the database has to be made active using USE command.

mysql> use OSResult

After creating and using the database you have to create tables. A table is created using the CREATE TABLE command as follows:

CREATE TABLE <TableName>
(<ColumnName1><Data Type1> NOT NULL,
<ColumnName2><Data Type2> default NULL,
.
.
<ColumnNameN><Data TypeN> default <some value>
);

Notes

A data type specifies what kind of values can be stored in a column. In MySQL various data types available are:

Data Type	Syntax	Usage	Example
Char	CHAR(n) – where n is a natural number.	For a fixed length column which can store a maximum of 255 character.	CHAR(5) specifies that a column can store a string of upto 5 characters.
Varchar	VARCHAR(n)–where n is a natural number	For a variable length column which can store a maximum of 255 character.	VARCHAR(5) specifies that a column can store a string of upto 5 characters.
Integer	INT or INTEGER	For columns storing integer values in the range -2147483648 to 2147483647.	
Decimal	DECIMAL(m,d)– where m and d are natural numbers.	For columns storing numerical values with fractional part also.	DECIMAL (6,4) specifies that a column can store values in the range -99.9999 to 99.9999
Date	DATE	For columns storing dates	For Date of Birth, Date of Joining etc.

NULL / NOT NULL is used to specify if we want to allow blank values in a column or not. The keyword ‘default’ is used to add a default value for any column. For e.g., default NULL or default TIMESTAMP. Let us create a table that has some information about the items sold at a local shop. Let us call the table as “ITEMS” table.

To create the ITEMS table, we will give the following command:

```
create table ITEMS (item_code char(5), item_desc varchar(20) NOT NULL;
                    CP decimal(6,2), SP decimal(6, 2));
```

Here item-code, item-desc, CP, SP are column names. Column SP will not allow blank entries. You can view the structure of the table by using the command:

DESCRIBE <TableName>;

Or

DESC <TableName>;

For example, the command

desc items;

will display the structure of ITEMS table as follows:

Field	Type	Null	Key	Default	Extra
item_code	char(5)	YES		NULL	
item_desc	varchar(20)	YES		NULL	
CP	decimal(6,2)	YES		NULL	
sp	decimal(6,2)	NO		NULL	

Similarly, you can use the command to create the BILLS table and then display its structure.

After creating a table you have to enter data in the table. The process of entering data in a table is also called populating the table. You enter data in a table row-wise. To enter a row in a table you use the command INSERT INTO as follows:

INSERT INTO <TableName>

VALUES (<Value1>,<Value2>,… ,<ValueN>);

For example, to enter a record (row) in the ITEMS table, you use the command:

insert into items values (“A001”, “Curd - 1Kg Pack”, 50,60);

Here you should notice that the character (CHAR and VARCHAR) values are placed in double quotation marks. They can also be placed in single quotation marks. Similarly date (DATE) values must also be placed within quotation marks. Numeric values (INT and DECIMAL) must not be placed in quotation marks.

Let us insert some more rows in the ITEMS table by the commands:

insert into items values (‘A002’, “Curd - 0.5Kg Pack”, 27,35);

insert into items values (‘B010’, “Wheat Flour”, 18,20);

insert into items values (‘B011’, “Basmati Rice”, 35,42);

Now if you want to check the data in the table you use the SELECT command. The following command

select * from items;

will display the contents of the table as follows:

item_code	item_desc	cp	sp
A001	Curd - 1Kg Pack	50.00	60.00
A002	Curd - 0.5Kg Pack	27.00	35.00
B010	Wheat Flour	18.00	20.00
B011	Basmati Rice	35.00	42.00

SELECT is the most widely used command in SQL and has many variations. Now we will discuss this in detail.

SELECT

SELECT command is used to retrieve data from table(s). In its simplest form SELECT command is used to retrieve complete data from a table as follows:

SELECT * FROM <TableName>;

For example, to view all the data from ITEMS table we use the command:

select * from items;

If you want to view only specific columns of a table, you can specify the column names instead of asterisk (*) in the SELECT command as follows:

SELECT <ColumnName1>,<ColumnName2>. . <ColumnName n>

FROM <table name>;

For example, to view only the item description and selling price of items you use the following command:

SELECT Item_Desc, sp FROM ITEMS;

It will display the following:

Item_Desc	sp
Curd - 1Kg Pack	60.00
Curd - 0.5Kg Pack	35.00
Wheat Flour	20.00
Basmati Rice	42.00

The column names can be specified in any order. For example, to view SP, followed by Item_Desc, followed by CP, we use the command:

SELECT SP, Item_Desc, cp FROM ITEMS;

SELECT command can also be used to display calculated fields. For example, to view the profit on each item, we use the command:

Select item_desc, sp-cp from items;

This will display the following result:

item_desc	sp-cp
Curd - 1Kg Pack	10.00
Curd - 0.5Kg Pack	8.00
Wheat Flour	2.00
Basmati Rice	7.00

Data can be fetched from tables by using SELECT command. Conditioned data can be fetched by using WHERE clause. For example, if we want to fetch all the items that cost more than 30, we can use:-

Select * from items where CP > 30;

This will display the following result:

item_code	item_dese	CP	SP
A001	curd 1Kg Pack	50.00	60.00
B011	Basmati Rice	35.00	42.00

We can specify more than one condition in where clause to get more specified data. e.g., if we need to fetch the items whose CP is more than 30 but SP is less than 50, we can use:-

Select * from item where CP > 30 and SP <50;

As shown, we have to use 'and' or 'or' a combination of both to get any type of data that we want. Another example:-

Select * from item where (CP > 30 or SP > 30) and SP < 50;

It is important to use the braces for correct order of execution. It is interesting to see that we can fetch data from more than one table simultaneously by using these conditions in where clause and mentioning table names in from clause. For example:-

Select field1, field2, ..., fieldN from table1, table2 where condition1 AND/OR condition2 AND/OR condition....

Please notice, if the number of conditins are more then more time will be taken by the query for processing and fetching the results.

If we want to extract only unique values from any column we can use DISTINCT.

For example,

Select DISTINCT (CP), SP from ITEMS;

To sort the output based on any column in ascending or descending order, use ORDER BY

For example,

Select * from ITEMS ORDER BY SP DESC;

By default the order by will display the values in ascending order.

Modifying the structure of MySQL Tables

It is a command defined under Data definition language as it alters the structure of an existing table. It has different variations according to the operation to be performed. To add a new column to your existing table or remove a column you use alter command.

To add new columns in a table you use alter command as follows:

ALTER TABLE *table_name* **ADD** *(newcolumnname datatype (size), newcolumnname datatype (size),...)***;**

For example, to add 'profit' column in the ITEMS table you use the following command:

ALTER TABLE ITEMS **ADD** *(profit decimal (6, 2)***;**

The above command will add new column 'profit' to the 'ITEMS' table.

To remove a column in a table you use alter command as follows:

ALTER TABLE ITEMS **Drop** *profit***;**

The above command will drop a column 'profit', from the ITEMS table.

You can change the column definition by using alter command.

ALTER TABLE ITEMS **MODIFY** item_desc varchar(30);

This command will modify the existing structure of the table. In the above command, the column size of the column *item_desc* of a table items have been increased to 30 from 20.

UPDATE Query

You can update your data values of the table by using Update command as follows:

UPDATE *table_name* **SET** *field1=new-value1, field2=new-value2;*

Or

UPDATE *table_name* **SET** *field1=new-value1, field2=new-value2*

[WHERE *Clause***];**

Update command is use to update either all (without **where** clause) or selected data values (By using the **where** clause) of the table. One can update one or more fields of a same table under a single command by specifying the WHERE clause. It is a data manipulation command.

For example, to update the SP of the item B010 i.e. wheat flour from 20 to 22, you use the update command as follows:

UPDATE *ITEMS* **SET** *SP = 22*

WHERE *item_code = B010;*

This query will update the record whose id is B010. Its SP will be set to new value 22.

You can delete the data of a table by using Delete command as follows:

DELETE FROM *tablename***;**

Or

DELETE FROM *tablename* **WHERE** *search_condition***;**

Delete command is used to remove rows from the table. It can be used to delete either all the rows from the table or selected set of rows from the tables using where clause.

For example, to delete all the rows from the ITEMS table you can use the Delete command as follows:

DELETE FROM ITEMS;

The above command will delete all the rows from the table 'ITEMS' table.

DELETE FROM ITEMS WHERE *CP > 40***;**

The above command will delete the rows from the table 'ITEMS' that have CP greater than 40.

Drop command is used to remove the structure of the table from the memory. You can use drop command as follows:

Syntax:

DROP TABLE *table_name***;**

For example, to drop the structure of ITEMS table, you can use the drop command as follows:

DROP TABLE ITEMS;

The above command will drop the structure of 'ITEMS' table.

INTEXT QUESTIONS 23.2

1. Fill in the blanks:

   a. Oracle, MySQL, and PostgreSQL are examples of .... software.

   b. SQL is an abbreviation for ....

   c. .... is a language specially oriented around .... databases.

   d. .... consists of the commands which are used to create, modify, and remove objects in a database.

   e. Each command in SQL is terminated by a ....

2. State whether the following statements are true or false:

   a. MySQL is an open source free software.

   b. To run MySQL we can enter any password.

   c. DDL, DML, and DCL are three different languages.

   d. SQL is a case-sensitive language.

   e. In SQL, a statement may spread into multiple lines.

WHAT YOU HAVE LEARNT

- Database is an organized collection of data.
- Database management system is a software that allows us to manage computerized databases.

- Relation is a collection of data corresponding to the same kinds of entities in a database.
- An attribute corresponds to a column in a relation.
- The group of one or more columns used to uniquely identify each row of a relation is called primary key.
- A field or combination of fields which can be used as a primary key of relation is called a candidate key.
- Normalization is the process of analyzing the data to be represented and breaking it down into separate tables in accordance with the principles of relational structure.
- Data Definition Language consists of those commands that create, modify and remove objects in the database.
- Data Manipulation Language consists of those commands that are used to retrieve, manipulate and update data present in tables.
- Data Control Language consists of those commands that determine whether a user is permitted to perform a particular action.

TERMINAL EXERCISE

1. Create a following table:

a) Supplier

Field	Type	Null	Key
SNO	varchar(4)	No	Primary
SName	varchar(20)	Yes	
Status	number(4)	Yes	
City	varchar(20)	Yes	

b) Parts

Field	Type	Null	Key
PNO	varchar(4)	No	Primary
PName	varchar(20)	Yes	
Color	varchar(10)	Yes	
Weight	number(4)	Yes	
City	varchar(20)	Yes	

c) Project

Field	Type	Null	Key
JNO	varchar(4)	No	Primary
JName	varchar(20)	Yes	
City	varchar(20)	Yes	

d) SPJ

Field	Type	Null	Key	
SNO	varchar(4)	No		Foreign
PNO	varchar(4)	No	Primary	Foreign
JNO	varchar(4)	No		Foreign
QTY	number(4)	Yes		

2. Insert the following data in the respective tables:

a) Supplier table

SNO	SName	Status	City
S1	Smith	20	London
S2	Jones	10	Paris
S3	Blake	30	Paris
S4	Clark	20	London
S5	Adams	30	Athens

b) Parts table

PNO	PName	Color	Weight	City
P1	Nut	Red	12	London
P2	Bolt	Green	17	Paris
P3	Screw	Blue	17	Rome
P4	Screw	Red	14	London
P5	Cam	Blue	12	Paris
P6	Cog	Red	19	London

c) Project table

JNO	JName	City
J1	Sorter	Paris
J2	Display	Rome
J3	OCR	Athens
J4	Console	Athens
J5	RAID	London
J6	Eds	Oslo
J7	Tape	London

d) SPJ table

SNO	PNO	PNO	QTY
S1	P1	J1	200
S1	P1	J4	700
S2	P3	J1	400
S2	P3	J2	200
S2	P3	J6	400
S2	P3	J7	800
S3	P3	J1	200
S3	P4	J2	500
S4	P2	J2	200
S4	P6	J3	300
S4	P6	J7	300
S5	P1	J4	100
S5	P2	J4	100
S5	P3	J4	200
S5	P4	J4	800

3. Perform the following queries on the above data:

a) Find the supplier numbers of the supplies who supplies to project ‘J1’.

b) Find the supplier numbers of the supplies who supplies to project ‘J1’ with part ‘P1’.

Notes

c) Retrieve the project name where supplier ‘S1’ is supplying the parts.

d) Retrieve the color values for the parts supplied by supplier ‘S1’.

e) Retrieve the part numbers supplied to any project in ‘London’.

f) Retrieve the supplier number who supplies to London or Paris with Red color part.

g) Find the total quantity of part P1 supplied by supplier S1.

h) Find the total number of projects supplied by supplier ‘S3’.

i) Change the color of all Red parts to Orange.

ANSWERS TO INTEXT QUESTIONS

23.1

1. (a) Database
   (b) Redundancy
   (c) Relational
   (d) Foreign

2 (a) False (b) True
  (c) False (d) False
  (e) True

23.2

1. (a) RDBMS
   (b) Structured Query Language
   (c) SQL, relational
   (d) DDL (Data Definition Language)
   (e) ; (or) semicolon

2. (a) True (b) False
   (c) False (d) False
   (e) True

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24

WEB DESIGNING USING HTML

You have learnt about database management system in the previous lesson. Now you will learn about web designing using HTML. You must have used Internet a number of times. When you surf the Internet, you simply enter the address of the desired website in the browser's (Google Chrome, Internet Explorer, Mozilla Firefox etc.) address bar and press Enter key. The desired website opens. If you want to search for some information, you open a search engine, like Google or Bing, and enter the topic about which you want the information. The search engine finds a number of web sites containing relevant information. You can visit any of these websites and find the desired information. Have you ever wondered how is this information created and where is it stored on the Internet? There are lot of tools and devices which are involved in creating, storing, and accessing information on the Internet. In this lesson you are going to learn HTML, which is the basic and a simple language to create web pages.

OBJECTIVES

After reading this lesson, you will be able to:

- recall the components of web pages;
- define HTML;
- identify container elements and empty elements in HTML;
- create web pages containing formatted text.

24.1 COMPONENTS OF WEB PAGE

A webpage has lot of components like text, hyperlinks, form and images etc. You can open websites of ISRO (http://www.isro.gov.in) and Parliament of India

(http://parliamentofindia.nic.in) and through various links given you can see various pages of these sites. Try to understand that web pages contain different types of contents.

When you give the address of a website in a browser, the browser shows a page of the website. This page may contain text, images, audio, video, forms etc. A web site contains a number of such web pages which are linked to each other through hyperlinks. Following is the screen shot of a web page from the IRCTC web site:

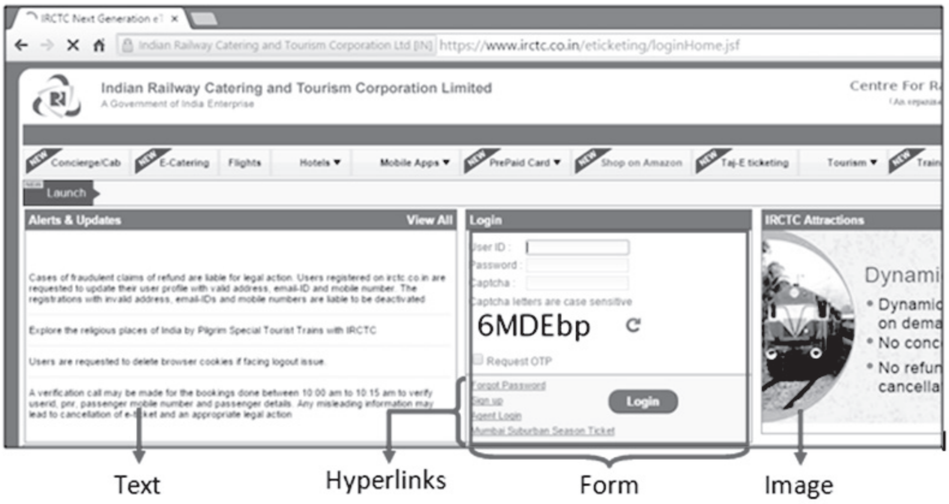


Fig. 24.1: Screen shot of a web page

Let us try to have a bird's eye view of how a web address, website, and web pages are related with each other. Suppose an organization wants to provide its information on the Internet. For this the organization will get all the information categorized into various categories. This information will then be converted into corresponding web pages. All these web pages collectively will form a website. To provide this information on the Internet, the organization has to get a website address and some space on some server where this website can be uploaded. Once this is done, the organization can upload its web site on the server and it will be globally available 24x7 through the website address.

Fig. 24.2: Creating a website

In this lesson we are going to learn how to create web pages with all such components and how to link these pages to create a website.

24.2 WHAT IS HTML?

HTML stands for Hyper Text Markup Language. It is the basic language used to create web pages. An HTML document is a text file and it can be created in any text editor (like Notepad2, Notepad etc.). This text file has to be saved with the extension *.html or .htm*. When an HTML document is opened in a web browser, the browser displays the document in the form of a web page.

An HTML document (a file with extension .html) contains a number of tags. A tag is a special word enclosed within angular brackets (< and >) which conveys some message to the browser. This message may be regarding the structure of the web page or formatting the contents of the web page. Accordingly the tags are called structural tags or formatting tags respectively. Examples of structural tags are <HTML>, <BODY>. <HEAD>. Examples of formatting tags are, <B>, <BR>, <HR>, <IMG>.

In an HTML document some tags appear in pairs. For example <HTML>. . </HTML> and <BODY> . . </BODY>. In such a case the first tag is the opening tag and the second tag is the corresponding closing tag. A closing tag always starts with slash (/). The portion of the html documents from starting tag upto the corresponding closing tag is an **element** and it is called a **Container Element**. Some of the tags do not need corresponding closing tag, like the tag <BR>. In such a case the tag itself is an **element** and it is called an **empty element.**

Sometimes you need to change the default behavior of HTML tags. This is done using tag's attribute(s). For example, <P> tag is used to start a new paragraph. By default, a paragraph is left aligned. If you wish to align a paragraph to the right or center, you use <P> tag with align attribute as follows:

Fig. 24.3: Tags and Attributes

Whenever you use an attribute, it has to be given some value using the = (equal) sign. Most, but not all, of the HTML tags have attributes.

The general structure of any HTML document is as follows:

```
<HTML>
<HEAD>
.                 Head element
.
</HEAD>

<BODY>
.                 Body element
.
</BODY>
</HTML>
```

Any HTML document starts with <HTML> tag and ends with </HTML> tag and contains two elements: **Head** element (optional) and **Body** element. The Head element (marked by <HEAD> . . </HEAD> tags) contains some information about the document. This information is not displayed in the browser window. The Body element (marked by <BODY> . . </BODY> tags) contains the information to be displayed in the browser window.

To learn this practically (it is always recommended), open a text editor and type the following text:

```
<HTML>
<HEAD>
<TITLE> Mello <TITLE>
</HEAD>
<BODY>
Hi! Welcome to my first web page. <BR>
I am learning HTML
</BODY>
</HTML>
```

Save this file with any file name and extension **.html** or **.htm** in any folder. Let us assume that you save it with the name **Page1.html**. The file extension **.html** tells the computer that it is an HTML document and should be opened in the browser. When you open this file in a web browser (say, Google Chrome), it will display the webpage as shwon in Fig 24.4.

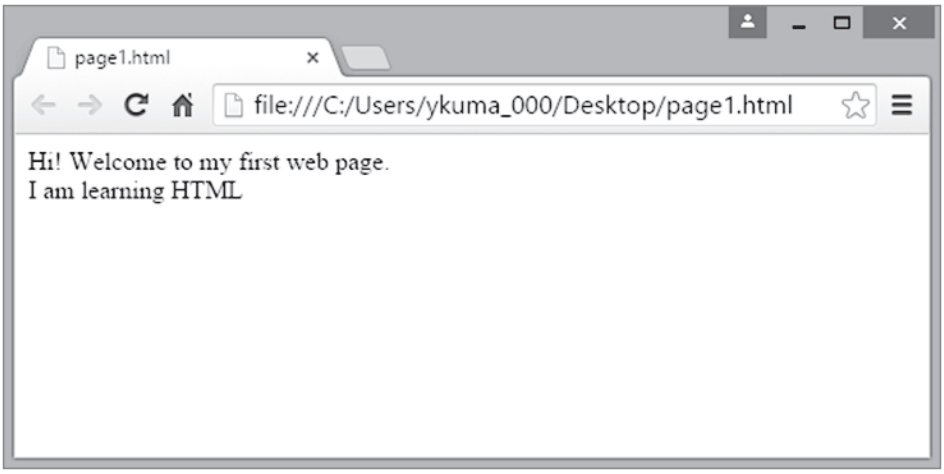


Fig. 24.4: Web page in a browser

INTEXT QUESTIONS 24.1

1. Answer the following questions briefly:
   a) Give examples of any two web browsers.
   b) What may be the contents of a web page?
   c) What are the two components of an HTML document?
   d) What is the extension of an HTML document?
   e) How do we assign a value to an attribute?
2. State whether the following statements are ture or false:
   a) A web page contains many web-sites.
   b) HTML is used to create web pages.
   c) A closing tag always starts with /.
   d) Behavior of attributes may be changed by using tags.
   e) Each tag in HTML has some attributes

24.3 INSERTING TEXT IN A WEB PAGE

To insert any text in a web page, you simply type that text in the body element of the HTML document. Whatever text you type, is taken as continuous text (without any break) by the browser. To display the formatted text in the web page you have to use various formatting tags in the HTML document. Let us understand this with the help of an example.

Suppose we want to create the following web page:

<u>Chanakya</u>

Chanakya was a professor of <u>economics</u> and <u>political science</u> at the ancient Takshashila University in India. He is widely credited for having played an important role in the establishment of the *Maurya Empire*. Chanakya served as the chief advisor to both Chandragupta and his son Bindusara.

Two books are attributed to Chanakya: **<u>Arthashastra</u>** and **<u>Chanakya Niti</u>**, also known as Chanakya Neeti-shastra.

The Arthashastra discusses monetary and fiscal policies, welfare, international relations, and war strategies in detail. The text also outlines the duties of a ruler. Some scholars believe that Arthashastra is actually a compilation of a number of earlier texts written by various authors, and Chanakya might have been one of these authors. Chanakya Niti is a collection of aphorisms, said to be selected by Chanakya from the various shastras. One of the quotes from Chanakya Niti is given below:

> *Whether it be big or small, we must do every work with our full capacity and power. This quality we must learn from the lion.*
> (It is believed that the lion never does anything half heartedly. It would kill a rabbit or attack an elephant with its full ferocity.)

`(Source: Wikipedia)`

Fig. 24.5: Sample web page 1

To create this web page you open a text editor and type the following:

```
<HTML>
<BODY>
                            Chanakya

Chanakya was a professor of economics and political science at the
ancient Takshashila University in India. He is widely credited for
having played an important role in the establishment of the Maurya
Empire. Chanakya served as the chief advisor to both Chandragupta and
his son Bindusara.

Two books are attributed to Chanakya: Arthashastra and Chanakya Niti,
also known as Chanakya Neeti-shastra.

The Arthashastra discusses monetary and fiscal policies, welfare,
international relations, and war strategies in detail. The text also
outlines the duties of a ruler. Some scholars believe that
Arthashastra is actually a compilation of a number of earlier texts
written by various authors, and Chanakya might have been one of these
authors.

Chanakya Niti is a collection of aphorisms, said to be selected by
Chanakya from the various shastras. One of the quotes from Chanakya
Niti is given below:

Whether it be big or small, we must do every work with our full
capacity and power. This quality we must learn from the lion.
(It is believed that the lion never does anything half heartedly. It
would kill a rabbit or attack an elephant with its full ferocity.)

                                           (Source: Wikipedia)
</BODY>
</HTML>
```

Fig. 24.6: Draft HTML code for the sample web page 1

While typing you find that in a text editor you cannot give desired formatting to the text. Somehow, you try to keep the text formatted as much as possible. But when you open the file in a web browser, you find that the whole text is shown as a single paragraph – No centering, no line-breaks, and no different paragraphs! It looks as follows:

Chanakya Chanakya was a professor of economics and political science at the ancient Takshashila University in India. He is widely credited for having played an important role in the establishment of the Maurya Empire. Chanakya served as the chief advisor to both Chandragupta and his son Bindusara. Two books are attributed to Chanakya: Arthashastra and Chanakya Niti, also known as Chanakya Neeti-shastra. The Arthashastra discusses monetary and fiscal policies, welfare, international relations, and war strategies in detail. The text also outlines the duties of a ruler. Some scholars believe that Arthashastra is actually a compilation of a number of earlier texts written by various authors, and Chanakya might have been one of these authors. Chanakya Niti is a collection of aphorisms, said to be selected by Chanakya from the various shastras. One of the quotes from Chanakya Niti is given below: Whether it be big or small, we must do every work with our full capacity and power. This quality we must learn from the lion. (It is believed that the lion never does anything half heartedly. It would kill a rabbit or attack an elephant with its full ferocity.) (Source: Wikipedia)

Fig. 24.7: Web page created by HTML code given in Fig. 25.6

To format the text as desired you have to apply different formatting tags to the text. The formatting tags needed to be used in this document are given in the following table:

Table 24.1: Formatting tags

	Tag(s)	Usage
1.	<CENTER> . . </CENTER>	To center align any part of the text
2.	<P> . . </P>	It starts a new paragraph. The text appearing after <P> appears in a new paragraph in the browser. <P> leaves a blank line before starting a new paragraph.
3.	 	It puts a line break in the text. The text appearing after appears in the next line in the browser. is different from <P>. <P> leaves a blank line before starting a new paragraph, whereas does not.
4.	<B> . . </B>	To make any part of the text **Bold**.
5.	<U> . . </U>	To underline any part of the text.
6.	<I> . .</I>	To *Italicise* any part of the text.
7.	<BLOCKQUOTE>.. </BLOCKQUOTE>	To indent the text (usually some quotations) from both sides – left and right.
8.	<FONT> . . </FONT>	To set specific font (face, color, size) for any part of the text.

We shall apply these tags to our document as follows:

<CENTER>..</CENTER>

The text heading appears in the center of the page. Therefore, it has to be enclosed in <CENTER>..</CENTER> tags as follows:

<CENTER> Chanakya </CENTER>

<P> . . </P>

First paragraph has to start after leaving one blank line above it. Therefore, we shall use <P> before starting the first paragraph as follows:

<P> Chanakya was a . . .</P>

Similarly, <P> will be applied before starting each paragraph (2^{nd}, 3^{rd}, 4^{th}, and 5^{th})

The parenthesized line after the quote is written without leaving a blank line above it. Therefore, we need a line break
 (Not <P>) to start it as follows:

**
(It is believed . . .**

<B>..</B>

The word **Chanakya** in the first paragraph appears in bold. Therefore, we have to enclose it in <B>..</B> tags as follows:

<B>Chanakya</B>

Similarly, the words **Arthashastra**, and **Chanakya Niti** in the second paragraph have to be put in <B>..</B> tags.

<U>..</U>

The word <u>economics</u> in the first paragraph is underlined. Therefore, we have to enclose it in <U>..</U> tags as follows:

<U>economics</U>

Similarly, the term <u>political science</u> has also to be enclosed in <U>..</U> tags.

<I>..</I>

The term *Maurya Empire* in the first paragraph is italicized. Therefore, we have to enclose it in <I>..</I> tags as follows:

<I>Maurya Empire</I>

<BLOCKQUOTE>..</BLOCKQUOTE>

The quotation in the last paragraph (along with parenthesized explanation) has to be enclosed in <BLOCKQUOTE>..</BLOCKQUOTE> tags as follows:

<BLOCKQUOTE>
<I>Whether it be . . . lion</I>
**
(It is believed . . . ferocity)**
</BLOCKQUOTE>.

<FONT>..</FONT>

The line at the end appears quite differently from the rest of the text. It has a different font face, size, and color. To apply a specific font to it, we have to enclose it in <FONT> . . </FONT> tags. Soon we shall study how to use <FONT>..</FONT> tags.

Notes

Applying multiple tags

In the above web page you observe that many parts of the text have multiple formatting. This concept is also called nesting of tags. In HTML you can apply multiple tags on the same part of the text, as shown below:

Table 24.2: Example of Multiple Tags

Text	Formatting	How to apply
Text heading **Chanakya**	Bold, Underline, Center aligned	<B><U><CENTER> Chanakya </CENTER> </U></B>
The words **Arthashastra** and **Chanakya Niti** in the second paragraph.	Bold, Underline	<U><B>Arthashastra</B></U> and <B><U>Chanakya Niti</U></B>
The quotation: *Whether . . lion.*	Blockquote, Italics	<Blockquote> <I>Whether . . lion. </I> </Blockquote>

Attributes

By default each paragraph is left aligned. To change the alignment of a paragraph to RIGHT or CENTER, you have to use ALIGN attribute of <P> tag. To have the desired font effects, you have to use <FONT> tag with FACE, SIZE, and COLOR attributes.

These attributes are given in the following table:

Table 24.3: Attributes of <p> and <font> tags

Tag	Attribute	Possible values of the attribute	Example
<P>	ALIGN	LEFT, RIGHT, CENTER, JUSTIFY	<P ALIGN = Right>
<FONT>	FACE	Any valid font name	<P FACE = "Arial">
	SIZE	An integer from 1 to 7	<P SIZE = 3>
	COLOR	Any valid color name or #RRGGBB code	<P COLOR = RED> or <P COLOR = #FF0000>

Following points should be noted while using attributes:

(i) An attribute is always paired with its valid value.

(ii) If the value of an attribute is a single word, then this value may be used with or without quotation marks. If the value of an attribute contains multiple words, then it must be used within double quotes.

(iii) If needed, multiple attributes can be used with a tag.

In our example web page we observed that the last line is right aligned. Therefore, we shall use <P ALIGN = Right> to start this line. This line is also written in some other FONT than the rest of the text. Therefore we shall enclose this line within <FONT> . . </FONT> tags as follows:

<FONT FACE=”Lucida Console” size = 2 color = red>
(Source: Wikipedia) **</FONT>**

Note that multiple attributes of a tag are separated by spaces. We can also use comma as a separator.

After applying all the suitable tags, final version of our HTML document is:

```
<HTML>
<BODY>
<B><U><CENTER>Chanakya</B></U></CENTER>
<P>
<B>Chanakya</B> was a professor of <U>economics</U> and <U>political science</U> at the ancient
Takshashila University in India. He is widely credited for having played an important role in the
establishment of the <I>Maurya Empire</I>. Chanakya served as the chief advisor to both
Chandragupta and his son Bindusara.
<P>
Two books are attributed to Chanakya: <U><B>Arthashastra</B></U> and <B><U>Chanakya Niti</B></U>,
also known as Chanakya Neeti-shastra.
<P>
The Arthashastra discusses monetary and fiscal policies, welfare, international relations, and
war strategies in detail. The text also outlines the duties of a ruler. Some scholars believe
that Arthashastra is actually a compilation of a number of earlier texts written by various
authors, and Chanakya might have been one of these authors.

Chanakya Niti is a collection of aphorisms, said to be selected by Chanakya from the various
shastras. One of the quotes from Chanakya Niti is given below:
<Blockquote>
<I>Whether it be big or small, we must do every work with our full capacity and power. This
quality we must learn from the lion. </I>
<BR>
(It is believed that the lion never does anything half heartedly. It would kill a rabbit or
attack an elephant with its full ferocity.) </Blockquote>
<P align = right>
<FONT FACE="Lucida Console" size = 2 color = red>
(Source: Wikipedia) </FONT>
</BODY>
</HTML>
```

Fig. 24.8: Final HTML code for the sample web page 1

Edit the document to apply the tags as shown above and open the document in a web browser to see the formatted web page.

INTEXT QUESTIONS 24.2

1. Fill in the blanks:

   a. .... tag is used to start a new paragraph.

   b. .... tag is used to center align any part of the text.

   c. .... tag is used to make any part of the text Bold.

d. .... tag is used to italicise any part of the text.

e. FACE is an attribute of .... tag.

2. State whether the following statements are ture or false:

a. There is no difference between <P> and <BR>.

b. Multiple tags may be applied on the same part of the text.

c. By default a paragraph is center aligned.

d. We can change the color of any part of the text.

e. A tag cannot have more than one attributes.

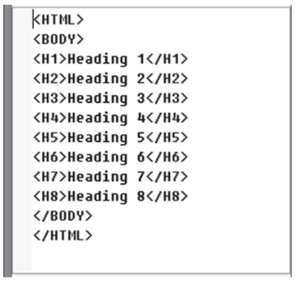
24.4 SOME MORE FORMATTING TAGS

Besides these, there are some other tags which are also used to format text. Let us learn these tags now.

Headings

Heading tags are used to format headings. These tags are used in the form <Hn> . . </Hn>, where n is a natural number in the range 1 to 6.

To view the effect of heading tags type the following code, save it as an HTML file and open it in a web browser.



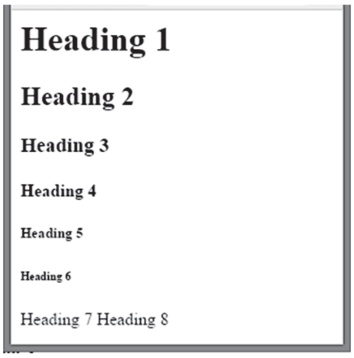


Fig. 24.9(a): HTML document

Fig. 24.9(b): Web page

Notice the following points as observed in the above example:

(i) <H1> gives the largest heading and <H6> gives the smallest. Size of text gradually decreases from <H1> to <H6>

(ii) Each heading starts as a new paragraph (and the text that follows it also starts as a new paragraph).

(iii) <H7> and <H8> are not valid tags, therefore these are totally ignored by the browser. This is true for all other tags also.

In the above page try to put the text heading in various heading tags and see the effect.

<HR>

<HR> tag is used to draw a horizontal line (Horizontal Rule) to separate two sections of a web page. You can define the width, size, color etc. of the horizontal rule by using the relevant attributes which are given below:

Table 24.4: Attributes of <HR> tag

Attribute	Possible values of the attribute	Description
ALIGN	LEFT, RIGHT, CENTER	To specify the alignment of horizontal rule
WIDTH	Any natural number OR n% , where n is a natural number in the range 0 to 100.	If width is a number, it is taken as the width of the horizontal rule in PIXELS.If width is a number%, it is taken as the %age of the browser window width. For example, 50% means half of the window width and 100% means full window width.
SIZE	A natural number	To specify the height/thickness of the horizontal rule in PIXELS.
COLOR	Any valid color name or #RRGGBB# code	To specify the color of the horizontal rule.
NOSHADE	No value	By default <HR> displays a shaded horizontal rule. NOSHADE specifies that it should be a solid, and not shaded, horizontal rule.

You can use <pre> tag to display a predefined text, i.e., the text inside <pre> ... </pre> tag will be displayed in a fixed width font and it preserves both spaces and line breaks.

Let us create an HTML file using the above mentioned attributes.

Notes

```
<HTML>
<BODY>
Following is a horizontal rule obtained with HR tag without any attribute
<HR>
Following is a horizontal rule obtained with attribute "WIDTH = 50"
<HR WIDTH = 50>
Following is a horizontal rule obtained with attribute "WIDTH = 50%
<HR WIDTH = 50%>
Following is a horizontal rule obtained with attribute "SIZE = 5"
<HR SIZE = 7>
Following is a horizontal rule obtained with attributes "SIZE = 3 COLOR = RED"
<HR SIZE = 3 COLOR = RED>
Following is a horizontal rule obtained with attributes "SIZE = 5 NOSHADE"
<BR>Observe that the attribute NOSHADE is used without any value
<HR SIZE = 5 NOSHADE>
Following is a horizontal rule obtained with attributes "SIZE = 5 COLOR = RED NOSHADE"
<HR SIZE = 5 COLOR = RED NOSHADE>
</BODY>
</HTML>
```

Fig. 24.10: HTML code to demonstrate the <HR> tag

The corresponding web page will be:

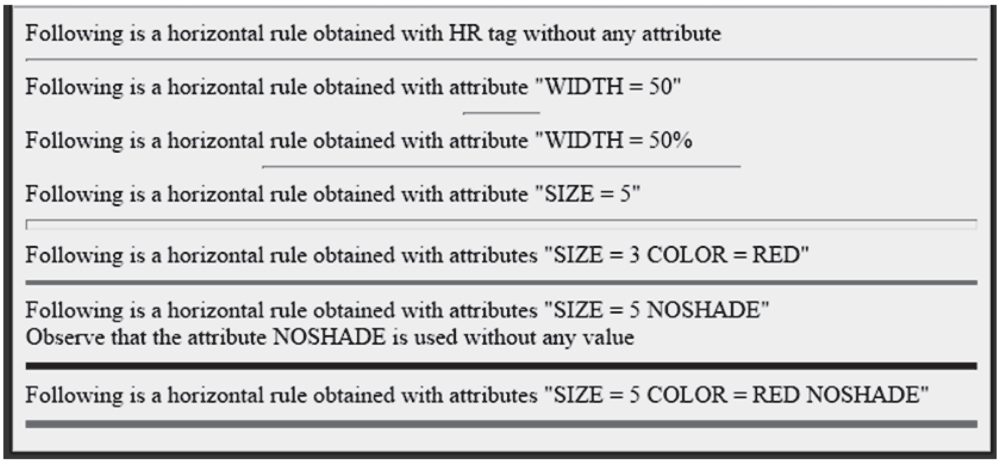


Fig. 24.11: Web page generated by code given in Fig. 24.10

24.5 PAGE SETTING

Page setting includes setting of page title and setting of page background color, text color etc. Page title is the text that appears in the title bar of the browser window. If an HTML document does not contain title, then the file name of the HTML document is displayed in the title bar. We can see in Fig. 24.4 that the file name Page1.html is written in the title bar of the browser window. Title of a page is set by TITLE element in the HTML document. The TITLE element is placed in HEAD element.

Syntax: **<TITLE>. . .</TITLE>**

Example:

<TITLE>Ancient India</TITLE>

Page background color and text color etc. are set by using various attributes of <BODY> tag. These attributes are:

(i) **BACKGROUND:** It is used to specify the image to be shown in the background of the web page. If the referenced image is smaller than the browser window, it will be tiled to fit and will scroll with the text on the page.

Examples:

a. <BODY BACKGROUND = logo.jpg>

b. <BODY BACKGROUND = "D:\HTML\Slate.jpg>

(ii) **BGCOLOR:** It is used to specify the background colour of the web page. Most of the browsers recognize most of the popular colour names like RED, GREEN, YELLOW, GREY, AQUA, etc. If we want to specify a colour which does not have a specific name but we know its RRGGBB composition, then you can specify this RRGGBB composition in the BGCOLOR attribute.

Examples:

a. <BODY BGCOLOR = CYAN> -specifying color name

b. <BODY BGCOLOR = #FF10AB> -specifying color code

(iii) **TEXT:** It sets the colour of the normal text in the document. Colour values can be given in the same way as that for the BGCOLOR attribute. The default text colour is black (with RRGGBB composition "#000000").

Examples:

a. <BODY TEXT = BLUE> -specifying color name

b. <BODY TEXT = #0010FF> -specifying color code

Let us now create another web page as shown in the Fig 24.12.

Fig. 24.12: Sample web page 2

Following is the HTML code to create this page:

```
<HTML>
<HEAD>
<TITLE>CDAC</TITLE>
</HEAD>
<BODY BGCOLOR = CYAN TEXT = BLUE>
<FONT FACE = "Trebuchet MS" COLOR = RED>
<CENTER><H1>CDAC - Centre for Development of Advanced Computing</H1>
<H5>(From Wikipedia, the free encyclopedia)</H5></CENTER>
</FONT>
<FONT FACE = "Trebuchet MS">
The Centre for Development of Advanced Computing (<B>C-DAC</B>) is a research and development
organization under the <U>Department of Electronics and Information Technology</U>, Govt of India. The
National Centre for Software Technology (NCST), ER&DCI and CEDTI were merged into C-DAC in 2003.
<HR NOSHADE>
<H3 ALIGN = CENTER>History</H3>
<P ALIGN = JUSTIFY>
After being denied <I>Cray</I> supercomputers as a result of a technology embargo, India started a
program to develop an <B>indigenous supercomputer</B> in collaboration with <I>Russia</I>.
Supercomputers were considered a double edged weapon capable of assisting in the development of nuclear
weapons. For the purpose of achieving self-sufficiency in the field, C-DAC was established by the
Department of Electronics in 1988. <U><B>Vijay Bhatkar</B></U> was hired as the Director of C-DAC. The
project was given an initial run of 3 years and an initial funding of INR30,00,00,000 as the same amount
of money and time was usually expended to secure the purchase of a supercomputer from the US.
<BR>
In 1990, a prototype was produced and was benchmarked at the 1990 Zurich Supercomputering Show. <B>It
surpassed most other systems, placing second after US</B>.
<BR>
The final result of the effort was the PARAM 8000, which was installed in 1991. It is considered India's
first supercomputer.
<HR WIDTH = 75% COLOR = BLUE>
<H3 ALIGN = CENTER>Research activities</H3>
Originally established to research and assemble High Performance Computers, the research of C-DAC has
spread to High Performance Computers, Grid Computing, Electronics, Speech and Natural Language
Processing, Information and Cyber Security, Ubiquitous Computing, Bioinformatics, and Geomatics
<HR>
```

Fig. 24.13: Code to create sample web page 2

WHAT YOU HAVE LEARNT

1. WWW (World Wide Web) is a collection of documents and services, distributed across the Internet and linked together by hyperlinks.
2. A website is a collection of interlinked web pages.
3. A web page may contain many components like text, hyperlinks, forms, images etc.
4. HTML (Hyper Text Markup Language) is the basic language used to create web pages.
5. An HTML document is a text file with the extension .html
6. A browser is a software which is used to surf the Internet.
7. When an HTML document is opened in a web browser, it is opened as a web page.
8. Contents of a web page are formatted by using various formatting tags in the corresponding HTML document.
9. HTML tags may be structural tags or formatting tags.
10. A container element starts with an opening tag and ends with a closing tag.
11. An empty element contains only the starting tag.
12. Attributes are used to modify the default behavior of tags.
13. Tags used in this lesson are: <HTML>. .</HTML>, <HEAD>. .</HEAD>, <TITLE>. .</TITLE>, <BODY>. .</BODY>, <CENTER> . . </CENTER>, <P> .. </P>, <BR>, <B>. .</B>, <U>. .</U>, <I>. .</I>, <BLOCKQUOTE>. .</BLOCKQUOTE>, <FONT>. .</FONT>, <HR>, <Hn>. .</Hn>
14. Multiple tags may be applied simultaneously on any part of the text as required.

TERMINAL EXERCISE

1. Define the following terms:

   WWW, HTML, Browser, Tag, Element

Notes

2. Differentiate between container elements and empty elements in HTML with an example of each.

3. Differentiate between structural tags and formatting tags in HTML with an example of each.

4. Give examples of two structural tags and two formatting tags in HTML.

5. What is the use of attributes? Explain with the help of an example.

6. Give the general structure of an HTML document.

7. Differentiate between <P> and <BR> tags in HTML.

8. What is the default alignment of a paragraph?

9. What is the use of <BLOCKQUOTE> tag? Explain with the help of an example.

10. What are the different attributes of FONT tag? Write the use of them.

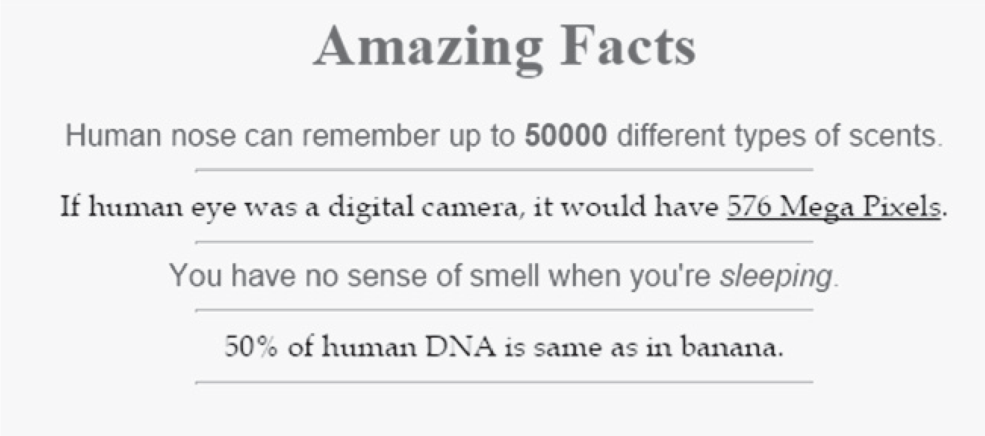
11. What is the use of heading tags? Which tags will you use to generate the largest heading and the smallest heading?

12. What is the use of <HR> tag? What are its attributes?

13. What is the use of <TITLE> tag? In which element is it used?

14. Differentiate between BGCOLOR and TEXT attributes of <BODY> tag.

15. Write an HTML code to create the following web page:



Amazing Facts

Human nose can remember up to **50000** different types of scents.

If human eye was a digital camera, it would have 576 Mega Pixels.

You have no sense of smell when you're *sleeping*.

50% of human DNA is same as in banana.

Following points should be considered while writing the code:

1. Title of the page is: "Human Body Facts".
2. Background color is "lightcyan" and the text color is set to "red".

3. The heading is written using <H1> and is center aligned.
4. The Horizontal Rules are 50% wide with respect to the browser window.

ANSWERS TO INTEXT QUESTIONS

24.1

1 a) Google Chrome, Internet Explorer

b) Text, Images, Hyperlinks, Forms etc.

c) Head and Body d) .html e) Using = (equal) sign

2 a) False b) True c) True d) False e) False

24.2

1 a) <P> b) <CENTER> c) <B> d) <I> e) <FONT>

2 a) False b) True c) False d) True e) False

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25

INSERTING IMAGES AND LISTS IN A WEB PAGE

In the previous lesson you have learnt how to create web pages with formatted text. You know that web pages also contain images. Images make a web page more colorful and interesting. If a web page contains text only then most of the people may not like to read it completely. A page becomes more interesting and attractive if it contains images to illustrate some concepts or just to show the images of some events or personalities. In this lesson you will learn how to insert images in a web page.

OBJECTIVES

After reading this lesson, you will be able to:

- identify image files by their file name extension;
- insert images in a web page;
- format images and text on a web page.

25.1 IMAGE FORMATS

Digital images exist in many different formats like JPEG, GIF, Exif, TIFF, RIF, PNG, BMP, and many more. Each of these file formats has its own pros and cons. For the web pages, best suited file formats are JPG, GIF, and PNG.

- JPG file format is the best option for images with lots of colors such as photographs. Their file size is also small and can be further reduced to suit the requirements.

- GIF file format is the best option for images with a few colors such as logos, pencil drawings etc. A lot of small animations are also available in the form of GIF files.
- PNG file format is the best option for images with transparency effects. PNG file format also supports lossless reduction in file size.

In any case the best way to judge the suitability of an image is your eyes. It is always a better idea to preview any web page before publishing (uploading it on the Internet) it.

25.2 INSERTING IMAGES IN A WEB PAGE

An image can be inserted in a web page by <IMG> tag with with the following attributes:

Attribute	Possible values of the attribute	Description
SRC	URL of the image to be inserted	Specifies the URL (Location + FileName) of the image to be inserted in the page. The Location part of the URL is optional if the image lies in the same folder in which web page is stored.
ALIGN	Top, bottom, middle, left, right	Specifies the alignment of the image according to surrounding elements
BORDER	Number	Specifies the width (in pixels) of the border around the image.
HEIGHT	Number	Specifies the height (in pixels) of the image.
WIDTH	Number	Specifies the width (in pixels) of the image.
ALT	Text	Specifies the alternate text to be displayed if the image is not available or cannot be displayed.

Out of these, SRC attribute is mandatory.

Example:

<IMG SRC = dream1.jpeg HEIGHT = 150 WIDTH = 200>

This statement will display an image dream1.jpg in the web page. Height and Width of the image are 150 pixels and 200 pixels respectively. The value of SRC attribute is just the file name. It means that the image exists in the same folder in which the web page is stored.

If the image is stored in the folder "M:\HTML\Image" and the web page is stored in some other folder, then the <IMG> element will be specified as follows:

<IMG SRC = "M:\HTML\images\dream1.jpeg" HEIGHT = 150 WIDTH = 200>

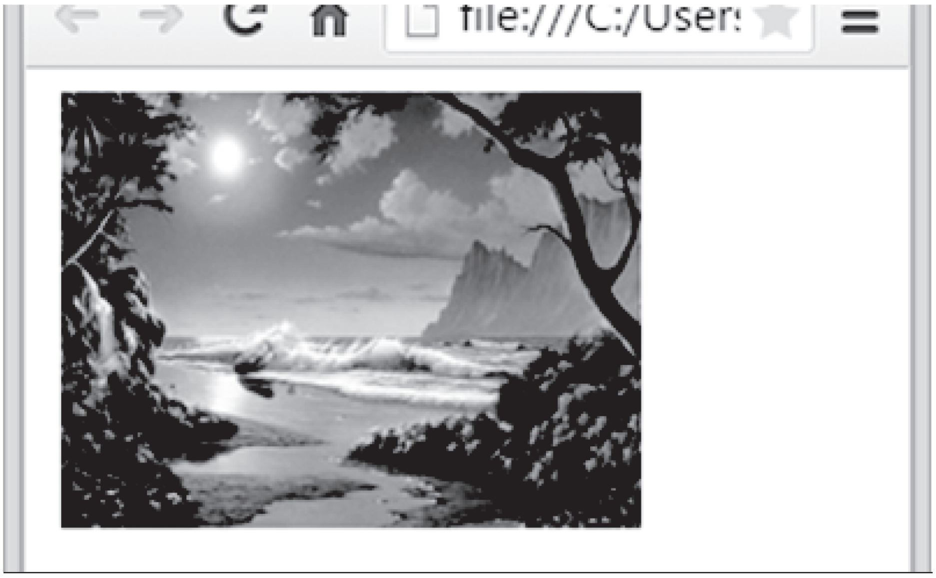


Fig. 25.1: The browser window

One <IMG> tag inserts one image in the web page. By using multiple <IMG> tags we can insert multiple images. Now let us see how various tags affect the appearance of an image.

Let us now see the effect of various attributes of <IMG> tag.

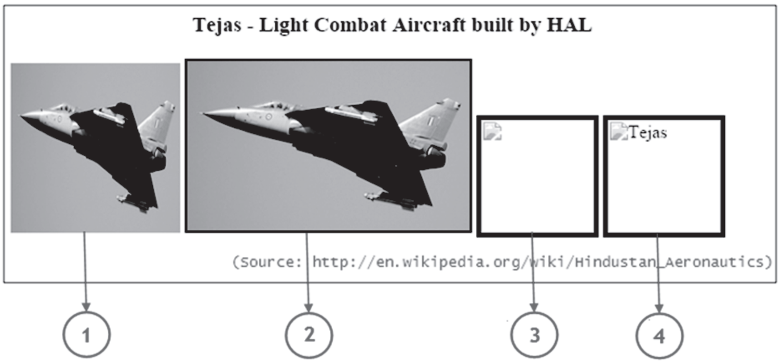
The HEIGHT and WIDTH attributes are used to specify the height and width both (in pixels) of the image to be displayed. If the size (height and width) of an image is not as per the requirements of a web page, we specify the display size of the image by using HEIGHT and WIDTH attributes of the <IMG> tag. If these attributes are not specified then the image will be displayed in original size.

BORDER tag is used to specify the size/width/thickness (in pixels) of the image border. If BORDER attribute is not specified then the images will be displayed without any border.

Sometimes, it may happen that the image to be displayed is not available or the image cannot be displayed in the browser. In such cases, the browser places a cross symbol (in place of the image) indicating that the image is not available or could not be displayed. The user does not get any clue about which image has to be displayed there. Using ALT attribute we can specify the alternate text to be displayed if the image is not available or cannot be displayed.

An example of these attributes is given below. Carefully go through the HTML code and the corresponding web page.

```
1  <html>
2  <head>
3  <title>Image Attributes - I</title>
4  </head>
5  <body>
6  <center><h3>Tejas - Light Combat Aircraft built by HAL</h3></center>
7  <img src = "images\Tejas.jpg" height = 150 width = 150 ALT = Tejas>
8  <img src = "images\Tejas.jpg" height = 150 width = 250 BORDER = 2 ALT = Tejas>
9  <img src = "images\Tejs.jpg" height = 100 width = 100 BORDER = 4>
10 <img src = "images\Tejs.jpg" height = 100 width = 100 BORDER = 4 ALT = Tejas>
11
12 <P align = right>
13 <FONT FACE="Lucida Console", size = 2, color = red>
14 (Source: http://en.wikipedia.org/wiki/Hindustan_Aeronautics) </FONT>
15 </body>
16 </html>
```



These four images, numbered 1,2,3, and 4, are due to statements numbered 7, 8, 9, and 10 respectively. You can easily observe the effect of various attributes.

Notice URL of the image in this example. The URL "images\Tejas.jpg" specifies that the image file, *Tejas.jpg*, lies in the sub-folder *images* of the current folder.

ALIGN Attribute

ALIGN attribute of <IMG> tag specifies the alignment of the image according to surrounding elements. Different possible values of ALIGN attribute and their effects are given in the following table:

value of ALIGN attribute	Effect
Left	Place the image at the left-most possible space in the window and wrap the other contents around the right hand side of that image.
Right	Place the image to the right-most possible space in the window.
Top	Aligns the top of the image with the top of the current line.
Middle	Aligns the middle of the image with the baseline of the current line.
Bottom	Aligns the bottom of the image with the baseline of the current line.

An example of ALIGN attribute with different values is given below. Carefully go through the HTML code and the corresponding web page.

```
<html>
<head>
<title>Human Body</title>
</head>
<body>
<img src = "images\ear.jpg" width = 100 height = 100 border = 2 align = top>
Image (ear) is aligned with ALIGN = Top.
<P>
<img src = "images\tongue.jpg" width = 100 height = 100 border = 2 align = middle>
Image (tongue) is aligned with ALIGN = Middle.
<P>
<img src = "images\skin.jpg" width = 100 height = 100 border = 2 align = bottom>
Image (skin) is aligned with ALIGN = Bottom.
<P>
<img src = "images\nose.jpg" width = 100 height = 100 border = 2 align = left>
Image (nose) is aligned with ALIGN = Left.
<P>
<img src = "images\eye.jpg" width = 100 height = 100 border = 2 align = right>
Image (eye) is aligned with ALIGN = right.
<P>
</body>
</html>
```

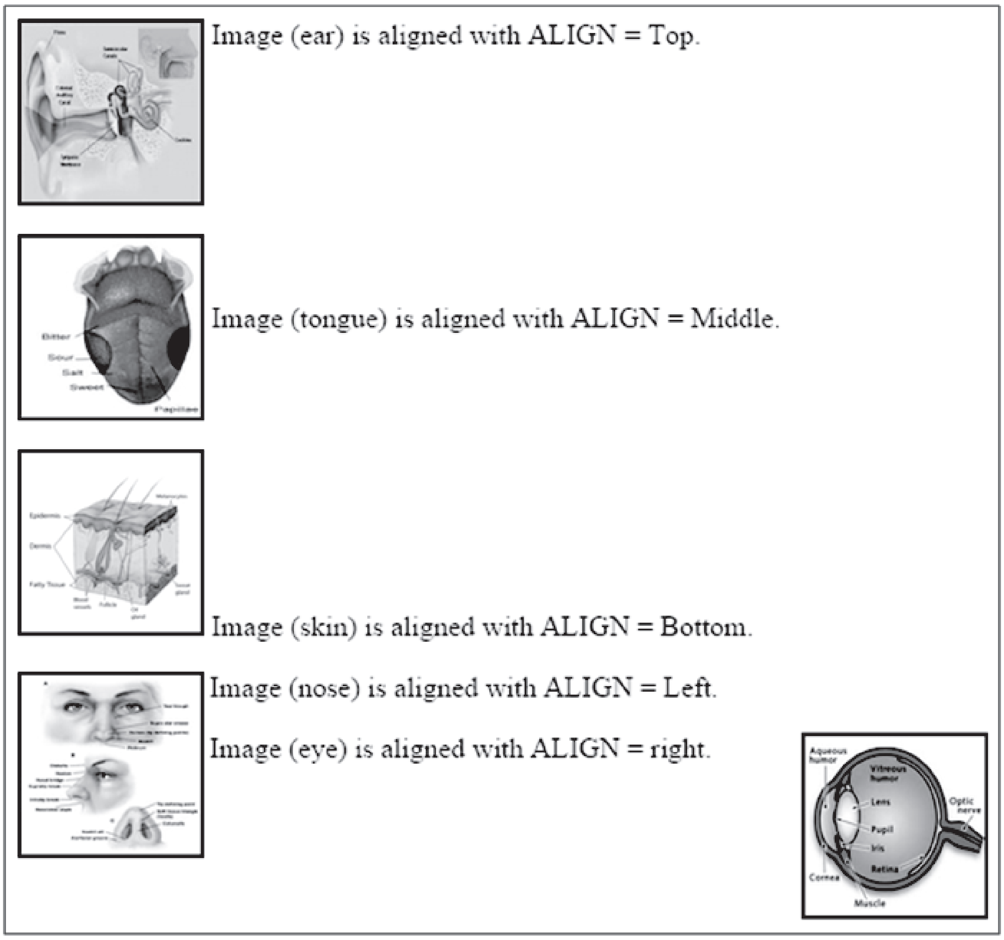


Fig. 25.2: Image tag with align attribute

INTEXT QUESTIONS 25.1

1. Fill in the blanks:

   a. .... file format is the best option for images with lots of colors such as photographs.

   b. .... file format is the best option for images with a few colors such as logos, pencil drawings etc.

   c. .... file format is the best option for images with transparency effects.

   d. .... tag is used to insert an image in a web page.

   e. BORDER attribute of <IMG> tag specifies the border width in ....

2. State whether the following statements are ture or false:

   a. <IMG> tag has a corresponding </IMG> tag.

   b. Using ALIGN attribute of <IMG> tag we can place an image in the center of the browser window.

   c. ALIGN = TOP places an image at the top of the browser window.

   d. Using SRC attribute of <IMG> tag, we specify the URL of the image to be displayed.

   e. BORDER attribute is used to specify border color of the image.

25.3 INSERTING LISTS IN A WEB PAGE

A list is a sequence of elements. Using HTML we can insert three types of lists in a web page. These lists are:

1. Unordered (Bulletted) Lists
2. Ordered (Numbered) Lists
3. Definition Lists

Unordered List

An unordered list is a bulletted list. An unordered list starts with <UL> and ends with </UL>. Items are inserted in the list using <LI> tag. An example of an unordered list is given below:

```
<UL>
<LI> Agricultural Aircraft </LI>
<LI>Fighter Aircrafts </LI>
<LI>Fighter Aircrafts </LI>
<LI>Helicopters</LI>
<LI>Engines </LI>
<LI>Trainer Aircrafts </LI>
<LI>Observation Aircrafts </LI>
<LI>Transport Aircrafts </LI>
</UL>
```

This is a part of an HTML document to show the unordered list only and will generate the following list:

- Agricultural Aircraft
- Fighter Aircrafts
- Fighter Aircrafts
- Helicopters
- Engines
- Trainer Aircrafts
- Observation Aircrafts
- Transport Aircrafts

Fig. 25.3: Unordered list

The shape of the bullets in a bulleted list can be changed by using the TYPE attribute of <UL> tag as shown in the following table:

Value of TYPE attribute	**Effect (Shape of the bullet)**
DISC	● (Filled Circle)
CIRCLE	o (Empty Circle)
SQUARE	■ (Filled Square)

For example, if we use TYPE attribute with <UL> in the above code, it will have the following effects:

<UL Type = DISC>(Default)	**<UL Type = CIRCLE>**	**<UL Type = SQUARE>**
● Agricultural Aircraft	o Agricultural Aircraft	■ Agricultural Aircraft
● Fighter Aircrafts	o Fighter Aircrafts	■ Fighter Aircrafts
● Fighter Aircrafts	o Fighter Aircrafts	■ Fighter Aircrafts
● Helicopters	o Helicopters	■ Helicopters
● Engines	o Engines	■ Engines
● Trainer Aircrafts	o Trainer Aircrafts	■ Trainer Aircrafts
● Observation Aircrafts	o Observation Aircrafts	■ Observation Aircrafts
● Transport Aircrafts	o Transport Aircrafts	■ Transport Aircrafts

Ordered Lists

An ordered list is a list in which elements are given sequence numbers. Such lists are generally created when order of elements in the list is important. An ordered list is created using <OL> tag in the HTML code. Different items in the list are inserted using <LI> tag as in an unordered list. An example of an ordered list is given below:

```
<OL>
<LI>Agricultural Aircraft </LI>
<LI>Fighter Aircrafts </LI>
<LI>Fighter Aircrafts </LI>
<LI>Helicopters</LI>
<LI>Engines </LI>
<LI>Trainer Aircrafts </LI>
<LI>Observation Aircrafts </LI>
<LI>Transport Aircrafts </LI>
</OL>
```

1. Agricultural Aircraft
2. Fighter Aircrafts
3. Fighter Aircrafts
4. Helicopters
5. Engines
6. Trainer Aircrafts
7. Observation Aircrafts
8. Transport Aircrafts

Using TYPE attribute of <OL> tag we can change the type of sequence numbers

<OL Type = 1>	<OL Type = I>	<OL Type = i>
1. Agricultural Aircraft	I. Agricultural Aircraft	i. Agricultural Aircraft
2. Fighter Aircrafts	II. Fighter Aircrafts	ii. Fighter Aircrafts
3. Fighter Aircrafts	III. Fighter Aircrafts	iii. Fighter Aircrafts
4. Helicopters	IV. Helicopters	iv. Helicopters
5. Engines	V. Engines	v. Engines
6. Trainer Aircrafts	VI. Trainer Aircrafts	vi. Trainer Aircrafts
7. Observation Aircrafts	VII. Observation Aircrafts	vii. Observation Aircrafts
8. Transport Aircrafts	VIII. Transport Aircrafts	viii. Transport Aircrafts
<OL Type = A>	**<OL Type = a>**	
A. Agricultural Aircraft	a. Agricultural Aircraft	
B. Fighter Aircrafts	b. Fighter Aircrafts	
C. Fighter Aircrafts	c. Fighter Aircrafts	
D. Helicopters	d. Helicopters	
E. Engines	e. Engines	
F. Trainer Aircrafts	f. Trainer Aircrafts	
G. Observation Aircrafts	g. Observation Aircrafts	
H. Transport Aircrafts	h. Transport Aircrafts	

We can also start the ordered list with a number other than 1 using START attribute of <OL> tag. START attribute can take any integer value with which we want to start the list. Two examples of lists with START attributes are given below.

<OL START = 4>	<OL Type = A START = 6>
4. Agricultural Aircraft	F. Agricultural Aircraft
5. Fighter Aircrafts	G. Fighter Aircrafts
6. Fighter Aircrafts	H. Fighter Aircrafts
7. Helicopters	I. Helicopters
8. Engines	J. Engines
9. Trainer Aircrafts	K. Trainer Aircrafts
10. Observation Aircrafts	L. Observation Aircrafts
11. Transport Aircrafts	M. Transport Aircrafts

Notice that START takes an integer value irrespective of the TYPE attribute.

Definition List

Definition Lists are used when some terms have to be defined. A definition list is created using <DL> tag. A definition list contains terms to be defined and their definitions. Terms to be definied are specified using <DT> tag and the corresponding definitions are specified using <DD> tag.

An example of a definition list to define some Aviation related terms is given below:

```
<DL><CENTER><B><U>Some Aviation Related Terms</U></B></CENTER>
<DT>Circumnavigation</DT>
<DD>traveling around something (by ship or plane); "Magellan's
circumnavigation of the earth proved that it is a globe"</DD>
<DT>Airliner</DT>
<DD>a commercial airplane that carries passengers</DD>
<DT>Amphibian</DT>
<DD>an airplane designed to take off and land on water</DD>
<DT>Biplane</DT>
<DD>old fashioned airplane; has two wings one above the other</DD>
</DL>
```

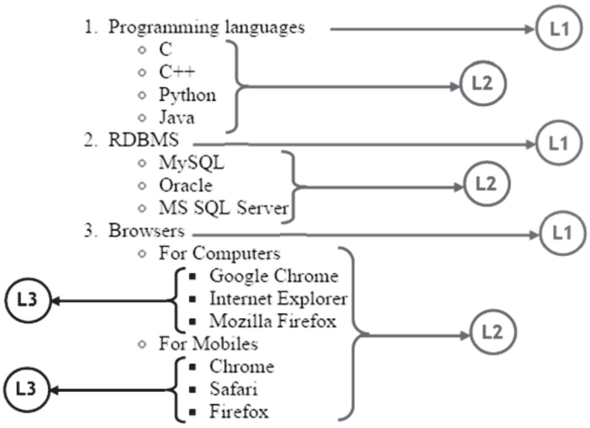
<u>Some Aviation Related Terms</u>

Circumnavigation
    traveling around something (by ship or plane); "Magellan's circumnavigation of the earth proved that it is a globe"
Airliner
    a commercial airplane that carries passengers
Amphibian
    an airplane designed to take off and land on water
Biplane
    old fashioned airplane; has two wings one above the other

Fig. 25.4: Definition list

Nesting of lists

In HTML we can nest lists into one another upto any level. An example of a nested list is given below:



This list is a numbered list (items marked *L1*) in which each item contains a bulleted (items marked *L2)*. The third item of the ordered list contains an unordered list in which each item again contains an unordered list (items marked *L1)*.

To write the HTML code for this list, we start with <OL> for the numbered list. The first item of this list contains some text (Programming Languages) and an unordered list. Therefore, the code goes as follows:

```
<OL>
    <LI>Programming languages
        <UL>
            <LI>C</LI>
            <LI>C++</LI>
            <LI>Python</LI>
            <LI>Java</LI>
        </UL>
    </LI>
    <LI>RDBMS
        <UL>
            <LI>MySQL</LI>
            <LI>Oracle</LI>
            <LI>MS SQL Server</LI>
        </UL>
    </LI>
    <LI>Browsers
        <UL>
        <LI>For Computers
            <UL>
                <LI>Google Chrome</LI>
                <LI>Internet Explorer</LI>
                <LI>Mozilla Firefox</LI>
            </UL>
        </LI>

        <LI>For Mobiles
            <UL>
                <LI>Chrome</LI>
                <LI>Safari</LI>
                <LI>Firefox</LI>
            </UL>
        </LI>
    </LI>
</OL>
```

1. Programming languages
   - C
   - C++
   - Python
   - Java
2. RDBMS
   - MySQL
   - Oracle
   - MS SQL Server
3. Browsers
   - For Computers
     - Google Chrome
     - Internet Explorer
     - Mozilla Firefox
   - For Mobiles
     - Chrome
     - Safari
     - Firefox

Like this we can nest any list (Unordered, Ordered, Definition) in any other (Unordered, Ordered, Definition).

Following is an example which combines the concepts of nested lists and images. The code is followed by the corresponding web page.

```
<html>
<head>
<title>HAL Products</title>
</head>
<body>
Partial List of In-house developed/under development
products of Hindustan Aeronautics Limited
<OL>

    <LI><B>Agricultural Aircraft</B>
        <IMG SRC = "images\hal_basant.jpg" height = 100 width = 150 align = middle>
        <UL>
            <LI>HA-31 Basant</LI>
        </UL>
    </LI>

    <P>
    <LI><B>Fighter Aircrafts</B>
        <IMG src = images\Tejas.jpg heigh t = 100 width = 150 align = middle>
        <UL>
            <LI>HAL Tejas</LI>
            <lI>HF-24 Marut</LI>
            <LI>Su-30MKI</LI>
            <LI>FGFA</LI>
            <LI>AMCA</LI>
        </UL>
    </LI>

    <P>
    <LI>Helicopters
        <IMG src = images\Dhruv.jpg heigh t = 100 width = 150 align = middle>
        <UL>
            <LI>Dhruv</LI>
            <LI>Light Combat Helicopter</LI>
            <LI>Light Observation Helicopter</LI>
            <LI>Indian multi-role Helicopter</LI>
            <LI>Rudra</LI>
        </UL>
    </LI>

    <P>
    <LI>Trainer Aircrafts
        <IMG src = images\Kiran.jpg heigh t = 100 width = 150 align = middle>
        <UL>
            <LI>HT-2</LI>
            <LI>HT-32 Deepak</LI>
            <LI>HJT-16 Kiran</LI>
            <LI>HTT-34</LI>
            <LI>HJT-36 Sitara</LI>
        </UL>
    </LI>
</OL>
</body>
</html>
```

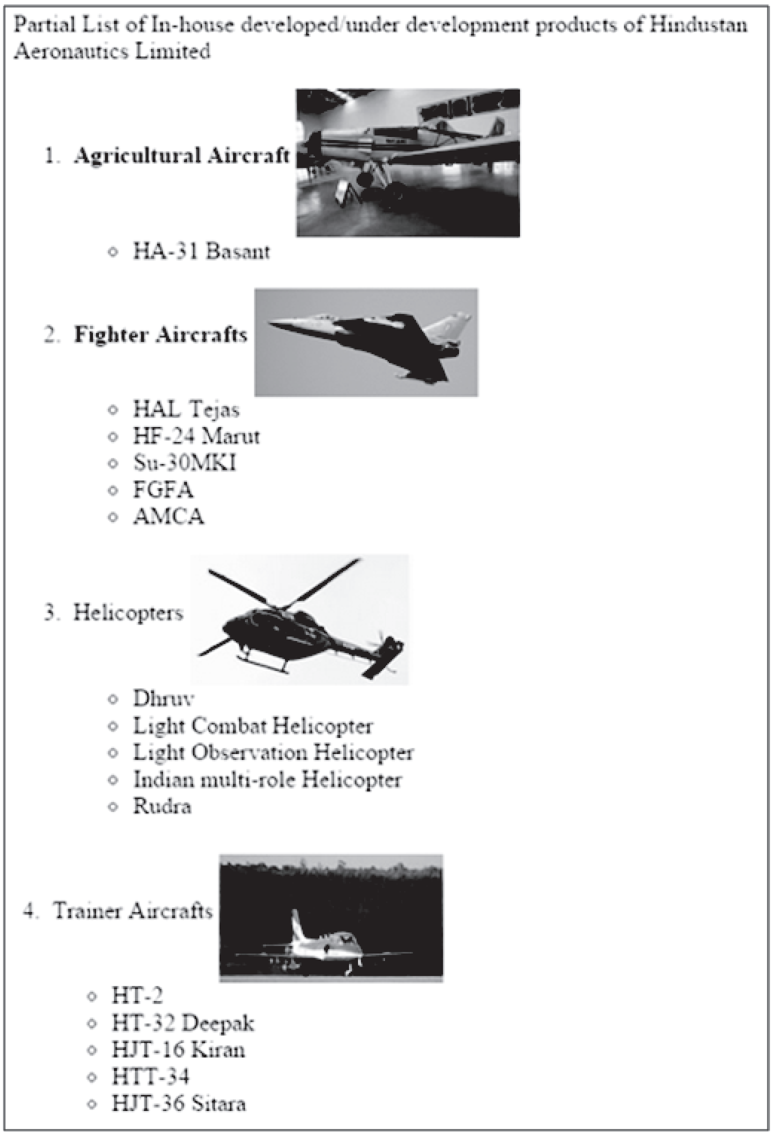


Fig. 25.5: Nested list with images

INTEXT QUESTIONS 25.2

1. Fill in the blanks:

   a. In an ___________ each item is preceded by a sequence number.

   b. ___________ tag is used to create an unordered list.

   c. ___________ tag is used to insert item in an ordered or unordered list.

   d. By default an ordered list starts with sequence number ___________ .

   e. Using ___________ attribute we can change the bullet types in an unordered list.

2. State whether the following statments are ture or false:
   a. <DT> tag is used to start a definition list.
   b. TYPE attribute can be used with <OL> as well as <UL> tag.
   c. We can nest an ordered list in an unordered list.
   d. Ordered list cannot be nested in a definition list.
   e. START attribute is used with <OL> tag.

WHAT YOU HAVE LEARNT

1. Digital images exist in many different formats.
2. JPG, GIF, and PNG formats of images are generally used n web pages.
3. <IMG> tag along with SRC attribute is used to insert images in a web page.
4. SRC, ALIGN, BORDER, HEIGHT, WIDTH, and ALT are the attributes of <IMG> tag.
5. Different types of lists can be inserted in a web page. The types of lists are: Unordered List, Ordered List, and Definition List.
6. Unordered lists are created using <UL> tag.
7. Ordered lists are created using <OL> tag.
8. <LI> tag is used to insert items in ordered and unordered lists.
9. Attributes of <OL> tag are TYPE and START.
10. Attributes of <UL> tag is TYPE.
11. Definition lists are created using <DL> tag.
12. In a definition list Definition Term is inserted using <DT> tag and Definition Description is inserted using <DD> tag.
13. Any type of list can be nested in any other type of list.

TERMINAL EXERCISE

1. Name any five digital file formats.
2. When are the following file formats suitable:

   JPG, GIF, PNG.

3. Which tag is used to insert images in a web page? How do we specify which image is to be inserted?

4. How is it possible to change the display size of the image without altering the original image?

5. What happens if the image to be displayed in the web page is not available? What is the use of ALT attribute in such a case?

6. What are the different possible values of ALIGN attribute of <IMG> tag? What are their effects?

7. What are the different types of lists that can be inserted in a web page?

8. Write an HTML code to create the following lists:

   Streams

   1. Non Medical science
   2. Medical science
   3. Commerece
   4. Humanities

   Subjects for Non-Medical Science

   - English
   - Computer Science
   - Physics
   - Chemistry
   - Maths

ANSWERS TO INTEXT QUESTIONS

25.1

1. a) JPEG	b) GIF	c) PNG	d) <IMG>	e) Pixels
2. a) False	b) False	c) True	d) True	e) False

25.2

1. a) Ordered List	b) <UL>	c) <LI>	d) 1	e) TYPE
2 a) False	b) True	c) True	d) False	e) True

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26

NEW TRENDS IN COMPUTING

You have learnt to insert images and lists in a web page in the previous lesson. This lesson is aimed to provide awareness about some of the latest technologies in the domain of computing and IT. With increase in usage of internet connectivity and need of high end computing, today's world is witnessing a shift from the era of mainframe computing and individual computing to a new era of mobile and green computing where the computing power, software and data are not necessarily located in office premises, rather, these can be stored somewhere in a "cloud" and can be accessed via internet at anytime and anywhere.

OBJECTIVES

After reading this lesson, you will be able to:

- define virtualization;
- list the types of computing;
- describe cloud computing;
- explain mobile computing;
- explore grid computing;
- use green computing.

26.1 VIRTUALIZATION

Literal meaning of virtualization is simulation. Virtualization allows the pooling and sharing of the computational power (processor, server) and storage of multiple computers, network and other resources among multiple users. This

simulation technique is adopted to give user a feel that all infrastructure (whether hardware or software) belong to user only. This is achieved by simulating the computational facility by creating a virtual version of given resource like for hardware platform virtual version of storage device, network resources can be made, and for software platform virtual version of operating system and other software is created. This virtual version provides a complete execution environment. A user is able to interact with these virtual resources as if it were a real single logical resource.

Concept of virtualization can be made clear with a common example of division of hard disk into different partitions. A partition is a logical division of a hard disk and it creates an effect of two separate hard disks to the user. This partition makes the management of files easier.

Virtualization is the ability to create a virtual copy of a device or some type of resource like server, storage, device, network and even operating system. It divides the multiple resources into different execution environments. Thus, one of the main objectives of virtualization is to centralize administrative tasks while improving scalability and workloads.

26.1.1 Architecture

Virtualization can be achieved at different levels. If you consider hardware, the organization needs:

- A large data storage system where complete data of an organization can be kept with complete security. Further, there should be a secured and reliable intra department access to database as per the policy.
- A high end server that can retrieve the data from the storage and process it with fast speed.
- A fast and reliable internet connectivity.

All these are required with an objective that the process is completed almost at the same instant the user has entered the necessary input data. As discussed earlier it is not possible to provide dedicated resources to each user, however we can give an illusion of dedicated resource through virtualization. Let us see how the server, network and storage virtualization is done.

26.1.2 Server Virtualization

It is a partition of a physical server into smaller virtual server. i.e., logically server resources were divided into multiple copies. The idea is to present the illusion of one huge machine that looks like many machines or multiple machines tied together to look like a single system.

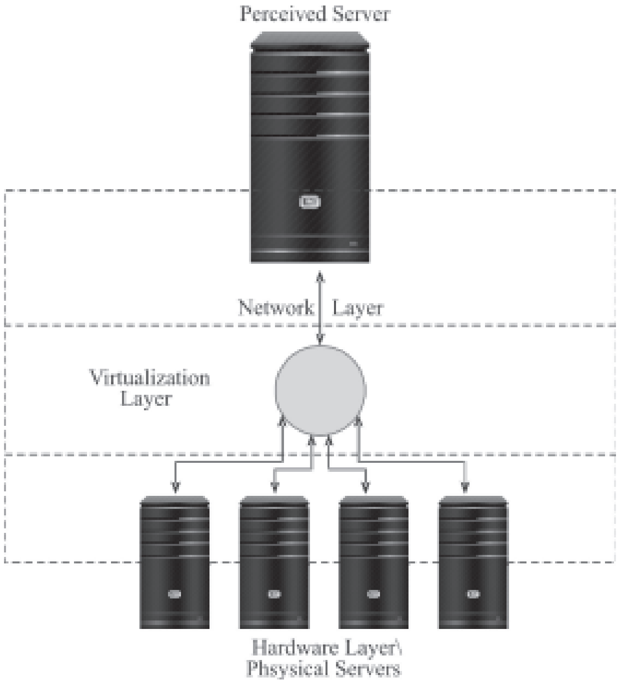

Fig. 26.1: Server Virtualization

26.1.3 Network Virtualization

The bandwidth available in the network environment is much more than is needed for a single user. Thus, for complete utilization of this bandwidth, it is required to partition the available bandwidth into channels. Each of which is independent from the other and each of which can be assigned to a particular server or device in real time.

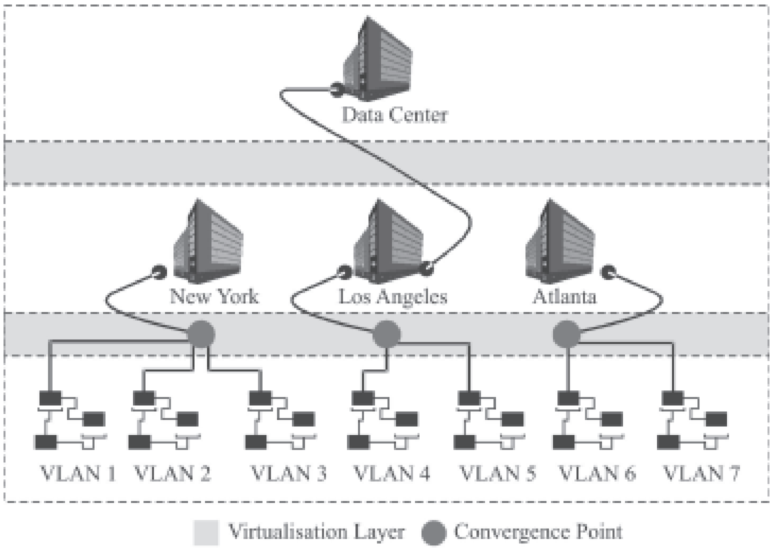

Fig. 26.2: Network Virtualization

26.1.4 Storage Virtualization

This is perhaps the most widely deployed and highly used virtualization practice. Storage virtualizaon allows separate storage devices to be combined into a perceived single unit. Storage virtualization attempts to maximize the efficiency of storage devices in information architecture.

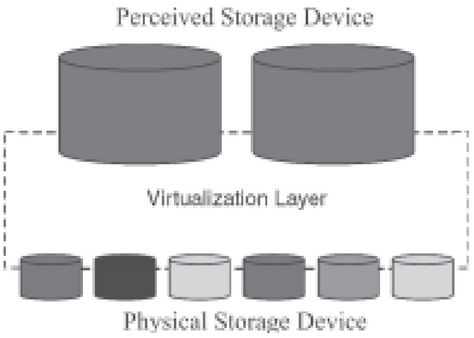

Fig. 26.3: Storage Virtualization

26.1.5 Software Virtualization

Operating system virtualization is to allow a piece of hardware to run multiple operating system images at the same time. It helps to accommodate multiple platforms simultaneously providing user more flexibility. Application software virtualization leads to create a logical image of application software to the user.

A system that provides both virtualizations of hardware as well as software is referred to as **Universal Virtualization**, as shown below:

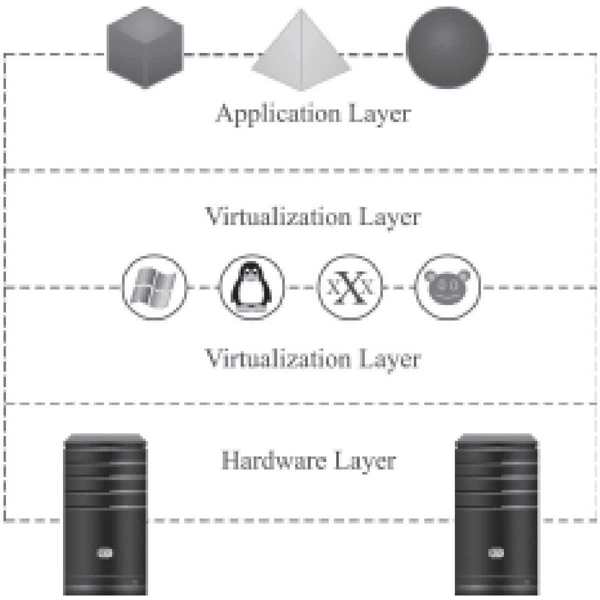

Fig. 26.4: Universal Virtualization

Advantages of Virtualization

- Improved hardware utilization: As the same resource is used by many users, utilization of resources is increased.
- Lesser hardware cost: You need lesser number of hardware resources, thus overall cost is reduced .
- Increased operational agility and reduced downtime: As more alternative resources are available, the system does not crash even if any one component goes out of order.
- As lesser resources are needed, this approach is considered to be more environment- friendly.
- Lower total cost of ownership.
- It improves overall efficiency and effectiveness of the system.
- Increased network capacity: channelizing the network increases the transmission capacity.

Disadvantages of Virtualization

- The various advantages of virtualization can be appreciated only if these benefits are achieved without compromising the overall security, reliability and availability of the IT infrastructure.
- The virtualized environment is considered more vulnerable as there are more chances of potential attack to gain unauthorized access to resources from guest operating systems.

26.2 CLOUD COMPUTING

As virtualization allows the user to access any resource by simulating a logical version of it, this technology gave an idea if you need any particular facility only for say one hour a day then why to pay for it for whole day or why to maintain the complete infrastructure if you can get this facility just by creating a logical version of it. Keeping these objectives in mind the idea of **pay-per-use** services was implemented through cloud computing. Cloud computing in simple words refers to selling any type of IT services including:

- delivery of resources via creating a virtual simulation of the resource.
- selling of application software.
- platform on which we need to execute the application.

All of these services are delivered through internet.

Cloud services allow individuals and businesses to use software and hardware that are managed by third parties at some remote locations. Examples of cloud services include online file storage, social networking sites, webmail, and online business applications. Thus, through cloud computing, one can increase its storage capacity, usage of high end server or adding computational capabilities without investing in new infrastructure, training new personnel, or licensing new software.

The cloud computing model allows access to information and computer resources from anywhere where a network connection is available. Cloud computing provides a shared pool of resources, including data storage space, networks, computer processing power, and specialized corporate and user applications. Cloud computing encompasses any subscription-based or pay-per-use service, that too, in real time over the Internet, thereby it extends existing IT capabilities of any organization by letting organization to pay just for the service it needs. The best feature of cloud computing is that it provides the end user many flexibilities like:

- Anything (i.e., any IT related service)
- Anywhere (at any place via internet)
- Anytime(at any instant of time)
- With any device that is compatible with internet usage

The following definition of cloud computing has been developed by the U.S. National Institute of Standards and Technology (NIST):

> "*Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*" This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models.

26.2.1 Essential Characteristics

The five essential characteristics that should be there in a computing environment so that it can be considered as cloud computing are:

- On-demand self service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

On-demand Self-service: As user you can request and manage your own computing resources as per your need i.e., the user can choose the computing capabilities, such as server time, network bandwidth, storage capacity etc. These requests are fulfilled automatically without requiring human interaction.

Broad Network Access: You can access the given service over the internet or private network. Thus it is required that all cloud services should always be available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

Resource Pooling: Pooled resources mean that user can select any resource from a pool of computing resources. Examples of resources include storage, processing, memory, network bandwidth, and virtual machines. The cloud service provider need pool of all computing resources to serve multiple users using a multi-tenant model, with different physical and virtual resources. These resources are dynamically assigned and reassigned according to user demand. The user generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or data centre). Thus, for the end user, resource usage is independent of its location.

Rapid Elasticity: The services, which are provided, can be rapidly and elastically changed. To the user all these services are available and can choose any one of them. It should appear to the user that all services are unlimited and can be purchased in any quantity at anytime from anywhere.

Measured Service: Cloud systems automatically control and optimize resource use by leveraging a metering capability according to the type of service (e.g., storage, processing, bandwidth, and active user accounts) i.e., the service provider will charge the user as per the usage of IT services. Resource usage can be monitored, controlled, and reported providing transparency for both the service provider and user who are utilizing the service. The resource service which is provided can be scaled larger or smaller; and according to the use of a service (type of service and amount of time which this service is used, also on number of user) the customers are billed.

You can say, through cloud computing, service provider provide access to software, platform or infrastructure on a basis of demand raised by user and user has to pay for it on a metered basis.

26.2.2 Three Services

The cloud computing can be accessed for usage of any particular software, platform or the complete infrastructure. Based on these the following three services are characterized:

Cloud Software as a Service (SaaS): This service provides user a capability to use any applications (which are developed by service provider) by executing it on a cloud infrastructure i.e., any pre-made application, along with the required software, operating system, hardware and network, is provided by the service provider. The applications are accessible from various client devices through Internet via a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

Examples: Many of the most popular cloud-based applications are business productivity tools such as email (e.g., Gmail, Hotmail), online productivity software (e.g., Google Docs, Microsoft Office 365), conferencing services (e.g., Microsoft LiveMeeting,WebEx), and customer relationship management software (e.g., Salesforce).

Cloud Platform as a Service (PaaS): This service provides user a capability to deploy user-created or acquired applications onto the cloud infrastructure. This application is created using programming languages and tools supported by the cloud service provider. Thus cloud service provider provides an operating system, hardware, and network where the user installs or develops their own software and applications. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

*Examples:*Google App Engine allows developers to create and run web applications that run on top of a custom Google platform and use Google's computing resources.

Cloud Infrastructure as a Service (IaaS): This service provides user a provision processing, storage, networks, and other fundamental computing resources, such that, the user is able to deploy and run arbitrary software, which can include operating systems and applications. Thus IaaS model provides just the hardware and network, and the user can install operating systems, software and applications. Although here also user does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of selected networking components (e.g., host firewalls).

Examples: cloud storage (e.g., Data centres), providing users access to scalable online storage.

26.2.3 Cloud computing Deployment Models

There are four different ways through which a cloud computing can be deployed.

Private Cloud: The cloud infrastructure is used exclusively by an organization. These are usually used by large organizations which have multiple business units. It may be managed by the organization itself or by some other third party. It can be deployed either in premises (on-site) or off premises (off site).

Community Cloud: The cloud infrastructure is shared exclusively by a specific group of organizations, especially those, sharing common concern (e.g., business interest, mission or goal, security requirements, policy, and compliance considerations). Similar to private cloud, it may be managed by the organizations or a third party and may exist on premises or off premises.

Public Cloud: The cloud infrastructure is made available for the use to the general public or a large industry group and is owned by an organization selling cloud services. Examples of public clouds are Amazon EC2, Amazon S3, Google, Microsoft Azure etc.

Hybrid Cloud: The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., "cloud bursting" for "load-balancing" between clouds).

Advantages of Cloud Computing

- It creates a more flexible environment that allows organizations to "rent" computing power on requirement.
- An organization can scale up or down its IT usage, according to demand.
- No need to procure space for creating infrastructure.
- Provide more mobile solution i.e., it is not necessary for the user to be in office to access the information. He or she can access the information through mobile also.
- Organization can build its infrastructure on its actual use of IT resources, rather than creating an overbuilt capacity, based on potential demand. Potential demands can be met by renting services through cloud.
- Organizations can easily upgrade their applications as they can change platforms simply by switching cloud service providers.

INTEXT QUESTIONS 26.1

Choose the appropriate answer.

1. .... allows the pooling and shaing of resources among multiple users.
   (a) Virtualization
   (b) Resource pooling
2. Which of the following is not an essential characteristics of cloud computing.
   (a) On demand self service
   (b) Static environment
   (c) Resource pooling
   (d) Rapid elastisity
3. A system that provides both virtualizations of hardware as well as software is referred to as ....
   (a) Universal virtualization (b) Storage virtualization

26.3 MOBILE COMPUTING

The advancement in technology of portable computers, which are capable of accessing the wireless technology, has made a huge revolution in the domain of Information and Communication Technology. It has given birth to new era of mobile computing, a platform that allows mobile user to have a versatile communication with other people and notification of events, messages and allows continuous access to services and resources of land based network.

Mobile computing is an umbrella term used for describing the technologies that enable people to access network services any place, any time, and anywhere. It is an extension of mobile voice communication technology which is capable of sending and receiving data across the cellular network.

Mobile computing basically involves designing of application and resolving technical issues of the people who are on move around within a region or country, or travel between countries and continents. Mobile data communication has become a very important and rapidly evolving technology as it allows users to transmit data from remote locations to other remote or fixed locations. This proves to be the solution to the biggest problem of business people who are frequently on the move.

In simple terms Mobile computing can be defined as a computing environment over physical mobility.

OR

"A technology that allows transmission of data, via a computer, without having to be connected to a fixed physical link."

OR

"Mobile computing is the ability to use computing capability without a pre-defined location and/or connection to a network to publish and/or subscribe to information."

Here you need a computing environment which is mobile and moves along with the user. For that you need a computing environment which fulfils the three important needs namely:

- Wireless communication
- Mobility
- Portability

Wireless Communication: In mobile computing platform, information between processing units flows through wireless channels. The demand for mobile communication creates the need for integration of wireless networks and existing fixed networks.

- **Local Area Networks:** standardization of IEEE 802.11 or HIPERLAN for handling interoperability and issues between different wireless LANs.
- **Wide Area Networks:** GSM and ISDN for global access.
- **Internet:** Mobile IP extension of the Internet protocol (IP).

Common technologies used are IR (Infrared Receivers), BlueTooth, W-LANs, Cellular, W-Packet Data networks, SAT, etc.,

Mobility: Mobile computing needs that device should be able to remain connected with network while changing its location. Different aspects of mobility are:

- **User Mobility:** Users communicate "any time, anywhere, with anyone" (example: read/write email on web browser).
- **Device Mobility:** A small battery driven devices that can be connected any time, anywhere to the network.
- **Session Mobility:** A user session should be able to move from one user-agent environment to another.
- **Service Mobility:** User should be able to move from one service to another.

Portability: It is not feasible to carry a desktop because of its size, weight and heat dissipation. You need a portable device that is small, light weighted, durable, capable to be operational under wide environmental conditions and having a battery with long life. To develop a mobile computing environment, you need a wireless communication facility, a mobile PC or mobile device and software which is specially designed keeping in mind the needs of mobile device and the user of mobile device.

Mobile Data Communication: Whenever a user is using a mobile, he / she will be using different networks at different places at different times as discussed earlier. Some common examples are GSM, CDMA, Ethernet, Wireless LAN, Bluetooth etc. Mobile laptop and notebook computers can use one of two types of wireless access services when away from home or office. The most commonly used and least expensive is Wireless Fidelity also known as WiFi. The WiFi uses radio waves to broadcast an Internet signal from a wireless router to the immediate surrounding area. An alternative to WiFi is cellular broadband. This type of mobile computing technology utilizes a cellular modem to connect to cell towers for Internet access.

Mobile Device: Mobile telephony took off with the introduction of cellular technology which allowed the efficient utilization of frequencies, enabling the connection of a large number of users. There are many different types of mobile computing devices designed to make it easier to travel and conveniently access technology on the go. Notebooks are small laptop computers that typically feature built-in wireless networking, and are great choices for those who want to work even while travelling. Mobile computing devices with a smaller size, such as smart phones or tablet computers, are becoming very popular as they are much easier to carry and now-a-days, these devices include many advanced features of computing, even comparable to those found on a laptop computer. Common devices that are used in mobile computing are

- Notebook PCs
- Personal digital assistant/enterprise digital assistant
- Smartphone
- Tablet computer
- Ultra-Mobile PC
- Wearable computer
- Palmtops
- Cell phones
- Pagers
- Sensors

Notes

Mobile Software: Mobile applications commonly called mobile apps are the applications that run on a mobile device. These usually run on web browser (HTML, JavaScript, Flash, server-side components, etc). Designing software of mobile application is a challenging task.

One of the major constraint is that user of this technology demands intuitive user interfaces, fast response times, and deep relevant content, high processing (specially for gaming and multimedia application) but the device which are used for mobile applications usually have limited processing speed, storage, power backup and display facilities.

Mobile computing is widely used in:

- **Vehicles:** use of GPS in vehicles for identifying the area.
- **Nomadic User:** user usually uses laptop and connects to network.
- **Smart mobile phone:** widely used for playing games, up-to date information, e-mail facility.
- **Invisible computing, Wearable computing:** These are tiny embedded "computers" that can be worn by the user as an accessory and use Bluetooth over cable connections, for providing connectivity.
- **Intelligent house or office:** Using mobile computing control various functions of computers and embedded systems that are used in office or home.
- **Meeting Room/Conference:** Share data instantly, send a message to someone else in the room or secretly vote on controversial issues.
- **Taxi/Police/Fire Squad Fleet:** use this computing facility for remaining connected, for controlling and communicating.
- **Emergency Services:** Received information regarding the address, type and other details of an incident can be dispatched quickly, via a CDPD (Cellular Digital Packet Data) system using mobile computers, to one or several appropriate mobile units which are in the vicinity of the incident.
- **Disaster Relief:** After earthquake, tsunami, volcano eruption, etc. infrastructure cannot be established immediately but mobile communication is established via satellite or Ad-Hoc network and proves very advantageous for relief and early transmission of patient data to hospital.
- **Disaster Alarm:** With help of satellite communication and sensors one might be able to alarm disaster early, example: Tsunami.
- **Military / Security:** can be widely used during war for communication and controlling the weapons in real time environment.

Advantages of Mobile Computing

- As devices used in mobile computing are portable, it can be easily carried by the user. Hence it provides an opportunity to develop an environment, where user always has a computing facility.
- As these devices have Internet access, these provide the user a facility to seek any information at any time.
- These devices are typically GPS enabled.
- Usually devices are multimedia enabled and typically have cameras and microphones.
- Apps are free or low-cost.

Disadvantages of Mobile Computing

The following are not exactly disadvantages; rather these are some of the limitations of mobile computing:

- Limited screen size.
- Limited battery life.
- Limited processor speed.
- Limited and sometimes slow network access.
- Limited or awkward input: soft keyboard, phone keypad, touch screen, or stylus.
- Limited web browser functionality.
- Range of platforms and configurations across devices.

26.4 GRID COMPUTING

Grid computing applies the resources of numerous computers in a network to work on a single problem at the same time. Usually this environment is used for solving large scientific or technical problem where huge amount of computing is involved. A large project is divided among multiple computers to make use of their resources. However, in cloud computing, small applications run on different systems, simultaneously, enables communities ("virtual organizations") to share geographically distributed resources as they pursue common goals.

The prime objective of grid computing are:

- Sharing computing resources between organisations.
- Solving complex and other software applications that demand high computing by providing widespread access to powerful computers and storage.
- Integrating existing systems together.

"A computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational facilities".

As explained in the beginning of the lesson, this decade has emphasized on community learning, which use to develop a low cost high performance computing system, popularly called **clusters**. These clusters share their resources to overcome the resource related problems in application domains. Grid is an infrastructure that involves the integration of different application such that they collaborate with each other to get complex problem solved with an ease. It involves integration of various resources of computers, networks, database and scientific instruments, owned and managed by multiple organizations. This is an environment which provides a secure resource sharing across organizational boundaries i.e., through intra cluster communications.

Solving complex problems can be achieved through grid computing by:

- Simulation of large complex systems.
- Large scale multi site data mining, distributed data sets.
- Sharing the resources by simulating their virtual version.
- Interactive collaboration.
- Real-time access to remote resources.

Common grid applications are

- Distributed supercomputing
- High-throughput computing
- On-demand computing
- Data-intensive computing
- Collaborative computing

Advantages of Gird Computing

Cost effective way to utilize the given amount of computing resources by

- Virtualizing resources across an enterprise.
- Enabling collaboration of all virtual resources across the organizations or community.
- Identifying the underutilized resources.
- Performing load balancing of resources so that all resources are used equally.

26.5 GREEN COMPUTING

Popularity of Information and Communication Technology (ICT) has increased among common man and the hardware devices used in it have become an integral part of daily routine activities. Hence, it is very important to analyse the impact of this technology on the environment. Also, to make an attempt to develop a system which is environment friendly. The relationship of ICTs and the environment is studied in terms of three distinct kinds of effects:

- **Direct Effects:** This effect includes issues related to environmental changes that arise because of the design, production, distribution, maintenance and disposal of ICT goods and services.
- **Indirect Effects:** This effect includes issues related to environmental changes that arise because of the application and use of ICTs in different domains of society.
- **Systemic Effects:** This effect includes issues related to environmental changes that arise because of the changes in economic and social structures due to use of ICT products and services.

Impact of computer on environment needs to be studied from its manufacturing to its usage and disposal stages. As thousands of computers are used in every domain of life, great amount of power is used and a great amount of both paper and electronic wastes are produced.

Common hazards that arise as result of massive usage of computers and other computing devices in our life are:

1. Computers and office equipment play an increasingly large role in energy consumption. Desktop computers, fan, screen savers, scanners and other electronic technology account for the fastest growing source of energy consumption. Even presently, people do not use energy saving CRT and processor. Further, they keep the computer "ON" even when not in use and also do not adopt power saving strategies such as 'sleep' and 'standby' modes. As a result, such a system remains active 24 hours per day, 7 days per week.

   Possible solution: all computers in offices or home or any organization should have

   - LCD energy saving monitors.
   - CPUs that are ENERGY STAR. (ENERGY STAR certified technology allows computers to automatically switch to standby mode when inactive for a certain amount of time) and allowing for energy savings.
   - Making a practice of switching off equipments when not in use. The usual usage should be 8 hours per day, 5 days per week.

2. **Paper usage:** Eventhough it is believed that using an automated system will reduce the paper work in any organization but practically it is observed that it has increased the paper consumption as

   - Printing is often wasteful – It is common practice that the people take print outs of emails or meeting agendas.
   - printing out partial drafts.
   - maintain a hardcopy backup of entire data which often becomes obsolete once data changes.

   Possible Solutions:

   - Do not print unless not very urgent.
   - Awareness should be provided to the users that all information is stored in the computer and can be retrieved any time hence they need not maintain a hardcopy backup of every partial drafts also.

3. **Manufacturing and packing of computing devices:** Pollution is increased because there are toxic chemicals used in the manufacturing of computers and components.

   Solution: manufactures should use non toxic and recyclable material for manufacturing the products

4. **Disposal of unused devices:** The hardware technology changes very fast and as a result often people feel to replace their existing system. Disposal of these devices constitutes 20-50 million tons per year (about 5% of the total waste of the planet). This waste is also known as e-waste. The improper disposal of computers and components may lead to entry of these toxic material in our food chain and water

   Solution: proper reuse and recycling of the products.

   - ***Reuse:*** Organizations like play way schools, libraries etc. may not need a high end latest configuration system, and instead of disposing the entire system, one can donate a computer or even its components to organizations who need lesser quality computers.
   - ***Refurbish:*** Rather than discarding the computer completly on release of the next generation. One can even upgrade the system by just replacing the processor and memory chips. Hence, many components like monitor, cables, UPS, speakers, keyboard, mouse etc., can be used (i.e., need not be replaced). This results in upgrading of computing facility without increasing the e-waste.
   - ***Recycle:*** The companies that can recycle the plastics and other components, can also recycle the e-waste components.

The prime objective of green computing is study and practice of environmentally sustainable computing through Information Technology.

The objectives of green computing are similar to green chemistry i.e.,

- It should reduce the usage of hazardous materials for manufacturing any product.
- Enhance the energy efficiency of any product by reducing the power consumption of that product.
- Promote the recyclability.
- Usage of biodegradable products and factory waste.

Many corporate IT departments have taken lot of green computing initiatives to reduce the environmental impact. Green ICT and its services present opportunities to deliver low carbon footprints and mitigate carbon emissions because of the unique ability to make energy consumption and green house gas emissions visible through its products and services.

INTEXT QUESTIONS 26.2

Fill in the blanks.

1. .... computing allows transmission of data via computer without having to be connected to a fixed physical link.
2. Solving complex problems can be achieved through .... computing.
3. Prime objective of .... computing is study and practice of environmentally sustainable computing through Information Technology.

WHAT YOU HAVE LEARNT

- Virtualization allows pooling and sharing of the computational power and storage of multiple computers, network and other resources among multiple users.
- Cloud computing model allows access to information and computer resources from anywhere where a network connection is available.
- Mobile computing is the ability to use computing capability without a pre-defined location and /or connection to a network to publish and / or subscribe to information.

- Grid computing applies the resources of numerous computers in a network to work on a single problem at the same time.
- Objective of green computing is study and practice of environmentally sustainable computing through information technology.

TERMINAL EXERCISE

1. What is cloud computing?
2. What is virtualization and how does it improve resource utilization?
3. How can we develop eco-friendly environment for computing?
4. What is mobile computing and what are its applications?
5. What is grid computing and in which environment it is found very useful?

ANSWERS TO INTEXT QUESTIONS

26.1

1. (a) Vitualization
2. (b) Static Environment
3. (a) Universal virtualization

26.2

1. Mobile   2. Grid   3. Green

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27

PROJECT MANAGEMENT SKILLS

In the previous lesson you have learnt about new trends in computing. In this lesson you will learn about what is project, and how to manage projects. This includes planning, scheduling and executing the project. A project is a temporary task, designed to produce a unique product, service or result. Here, temporary does not mean a short duration but a definite beginning and end. The end of the project could be deduced if project objectives are met or if it becomes clear that the objectives cannot be met and need of project no longer exists.

OBJECTIVES

After reading this lesson, you will be able to:

- define a project;
- enlist the knowledge areas of project management;
- explain project communication management;
- describe software configuration management.

27.1 PROJECT

Projects are a means of organizing activities that cannot be addressed within the organization's normal operational limits. These are, therefore, often utilized as a means of achieving an organization's strategic plan. The presence of repetitive elements does not change fundamental uniqueness of the project. Projects are progressively elaborated, i.e., developed in steps and continued by increments.

Projects are typically authorized as a result of one or more of the following strategic considerations:

- An organizational need (e.g., to increase revenues)

Notes

- A technological advance
- A market demand
- A legal requirement
- A customer request

Now let us see the examples of a project.

- Developing a new product or service
- Effecting a change in structure, staffing, or style of an organization
- Designing a new vehicle
- Developing or acquiring a new or modified information system
- Constructing a building or facility
- Building a water system for a community
- Implementing a new business procedure or process

Project management is the application of skills, knowledge, techniques, and tools used to meet project requirements. These are accomplished through the application and integration of the Project Management processes. Usually, projects are constrained by 'Triple Constraint' (Scope, Time & Cost). If any one of the three factors change, at least one other factor is likely to be affected. The "triple constraint" is used to help evaluate competing demands, quality, risk and customer satisfaction.

Project management cannot begin without the presence of a project manager. A project manager is a person who is assigned the responsibility of executing the complete project. A project manager is expected to be thoroughly aware of all the phases that the project would go through.

A project manager is expected to closely monitor the development process, prepare and execute various plans, arrange necessary and adequate resources, maintain communication among all team members in order to solve the issues related to cost, budget, resources, time, quality and customer satisfaction of the project.

Few key responsibilities that a project manager owns are:

Managing People

- Association with stakeholders
- Reporting hierarchy
- Act as a project leader
- Managing human resources

Managing Project

- Project scope - defining and setting up
- Monitoring and controlling progress and performance
- Risk analysis at every phase
- Proactively taking necessary steps to avoid problems or to come out of problems
- Act as project spokesperson

Project Management - Knowledge Areas

- Project Planning
- Scope Management
- Project Estimation
- Scheduling of tasks and events
- Resource management

Project Planning

This is performed before the production of software starts. It is essential for the successful software production but involves no concrete activity that has any direct connection with software production. It is a set of multiple processes, which facilitate software production.

Scope Management

This process defines the scope of the project - includes all the activities, the processes that need to be carried out to make a deliverable software product. Scope management is essential because it defines boundaries of the project by clearly stating what would be done and what would not be done, in the project. This ensures that project contains limited and quantifiable tasks, which can easily be documented and in turn avoids cost and time overrun.

Scope management includes:

- defining the scope
- dividing the project into various smaller parts for ease of management.
- verifying the scope
- controlling the scope

Project Estimation

For an effective project management, accurate estimation of various measures is must. Correct estimation helps managers manage and control the project more efficiently and effectively. This includes:

- **Software size estimation**

  Software size is usually estimated in one of the following measures:

  - LOC (Line of Code) - Lines of code depend upon coding practices
  - Number of function points (FP) in the software - vary according to the user or software requirement.

- **Effort estimation**

  Efforts estimation is done in terms of man-hours required to produce the software and then the people needed for it. For effort estimation software size should be known. This can either be derived by organization's historical data, or managers' experience. Software size can be converted to efforts by using some standard formula.

- **Time estimation**

  Once size and efforts estimation is complete, the time required to produce the software can be estimated. Efforts required are further divided into sub categories as per the requirement specifications and interdependency of various components of software. Software tasks are broken down into smaller tasks, activities. The task scheduling is done on the day-to-day basis or in calendar months.

Total time invested in completing the project is the sum of the time required to complete all tasks in hours or days.

- **Cost estimation**

  Considered to be the trickiest of all, cost estimation depends on more elements than any of the previous ones. It is required to consider the following points:

  - Hardware
  - Additional software or tools, licenses etc.
  - Skilled personnel with task-specific skills
  - Size of software
  - Software quality
  - Travel involved
  - Communication
  - Training and support

Project Scheduling

In a project, project scheduling refers to a roadmap of all activities to be done in a specified order and within the time slot allotted to each activity. Project managers usually define various tasks and project milestones and then arrange them keeping various factors in mind. They look for tasks that lie in the critical (most important) path in the schedule, which are necessary to be completed within the time allocated. Arrangements of tasks that lie out of critical path are less likely to impact the overall schedule of the project.

For project scheduling, it is necessary to

- break down the project tasks into smaller, manageable form.
- estimate time frame required for each task.
- correlate various tasks.
- divide time into work-units.
- assign an adequate number of work-units for each task.
- calculate total time required for the project from start to finish.

Resource management

All elements that are used to develop a software product are considered as a resource for that project. This resource includes human resource, productive tools, and software licenses.

Notes

The resources are usually available in limited quantity and stay in the organization as an asset pool. The shortage of resources usually hampers the development of project and project can lag behind the schedule. Allocating extra resources usually increases the development cost in the end. It is, therefore, necessary to estimate and allocate adequate resources for the project.

Resource management includes -

- Defining proper team structure for the project by creating a project team and allocating responsibilities to each team member.
- Determining the resources required at a given stage/activity and ensuring their availability.
- Managing resources by creating resource request as and when they are necessary and de-allocating them when they are no longer required.

27.1.1 Project Risk Management

Project risk management includes all activities corresponding to identification, analysis and readying for predictable and non-predictable risks in the project. A risk may include the following:

- Fluctuating skill maturity - Experienced staff leaving the project and new employee coming in.
- Change in organizational leadership.
- Requirement change / misinterpreting requirement.
- Under-estimation of required time and resources.
- Technological changes, environmental changes, business competition.

Risk Management Process

Following activities are part of risk management process:

- **Identification -** Making a note of all possible risks, which may occur in the project.
- **Categorize -** Categorizing known risks into high, medium and low-risk intensity depending on their level of impact on the project.
- **Manage -** Predicting the probability of occurrence of risks at various phases. Making plans to avoid the occurrence of risks and attempting to minimize their side-effects.

- **Monitor** - Closely monitoring the potential risks and identifying early symptoms. Also monitoring the effect of steps taken to mitigate or avoid risks.

27.1.2 Project Execution – Monitoring and Control

In this phase, the tasks described in project plan are executed as per the defined schedule. Execution needs monitoring - to test whether everything is going according to the plan or not. Monitoring is - to check the probability of risk and to take steps to resolve the risk or report the status of various tasks.

These include -

- **Activity Monitoring** - All activities scheduled within some task are monitored on regular basis. When all activities in a particular task are completed, then the task is considered as completed.
- **Status Reports** - The reports contain the status of activities and tasks completed/in-progress/not started within a given time frame.
- **Milestones Checklist** - Every project is divided into a number of phases where major tasks are performed (milestones) based on the phases of Software Development Life Cycle. This milestone checklist is prepared and is revised / updated every few weeks. The status of each milestone is reported and reviewed.

27.2 PROJECT COMMUNICATION MANAGEMENT

Effective communication is essential for the success of a project. It bridges gaps between client and the organization, among the team members as well as other stakeholders in the project such as software / hardware suppliers. Communication can be oral or written. Communication management process usually has following steps:

- **Planning** - includes the identification of all the stakeholders in the project and the mode of communication among them. It also assesses if any additional communication facilities are required.
- **Sharing** - After determining various aspects of planning, the manager is expected to focus on sharing correct information with the correct person on correct time so that everyone involved in the project is up-to-date with project progress and its status.
- **Feedback** - Project managers use various measures like status and performance reports to get feedback. This mechanism ensures that input from various stakeholders come to the project manager.

- **Closure** - At the completion of each major milestone, end of a phase of SDLC or end of the project itself, the closure is formally announced to update every stakeholder by sending email or by distributing a copy of the document or by any other means of effective communication. After closure, the team moves to next phase or project.

27.3 CONFIGURATION MANAGEMENT

Software Configuration management is a process of tracking and controlling the changes made to the software in terms of the requirements, design, functions, and development of the product. IEEE (Institute of Electrical and Electronics Engineers) defines it as "the process of identifying and defining the items in the system, controlling the change of these items throughout their life cycle, recording and reporting the status of items and change requests, and verifying the completeness and correctness of items". Generally, once the requirements are finalized there is less chance of further requirement changes from the user. If they occur, the changes are accepted only with prior approval of higher management, as this could result in cost and time overrun.

27.3.1 Baseline

Baselining is an effective way to define the completeness of a phase. A phase is considered to be baselined only when all activities pertaining to it are finished and well documented. If it was not the final phase, its output would be used in next immediate phase. Configuration management takes care of occurrence of any change (process, requirement, technological, strategical etc.) after a phase is baselined. Regularly, Configuration manager checks the changes done in software.

27.3.2 Change Control

Change control is a function of configuration management, which ensures that all changes made to software system are consistent and made as per defined project/organizational rules and regulations.

A change in the configuration of product goes through following steps -

- **Identification** - change request arrives from either internal or external source change request is identified formally and is properly documented.
- **Validation** - Validity of the change request is checked and its handling procedure confirmed.
- **Analysis** – The impact of the change request is analysed in terms of required additional efforts, cost and schedule. Overall impact of the prospective change on system is thoroughly analysed and documented.

Notes

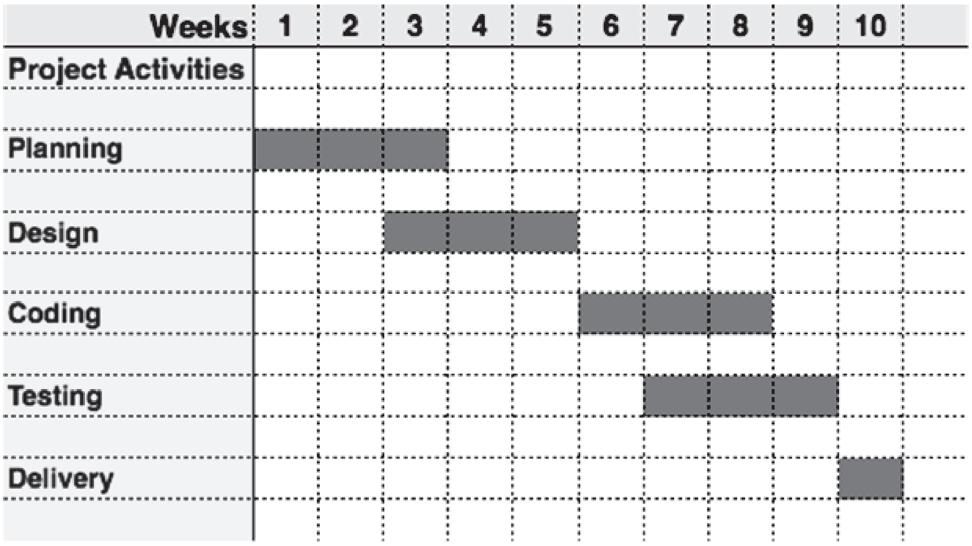
- **Control** - It is mandatory to take approval of high authorities before the change is incorporated into the system especially if the required additional change either impacts too many entities in the system or it is unavoidable. The decision is taken based on the fact that whether incorporating such changes will be worth or not. If it is not, change request is formally refused to be accepted.
- **Execution**–Once approved, the ongoing phase takes appropriate actions to execute the change, does a thorough revision to previous phases, if necessary. When executing a change request, the compatibility check of modified part with the other existing modules plays an important role.
- **Close request** - Change is verified for correct implementation and its integration with the rest of the system. The newly incorporated change in the software is well documented and then the request is formally closed.

27.4 PROJECT MANAGEMENT TOOLS

The risk and uncertainty associated with a project rise with the size of the project, even when the project is developed according to set methodologies. There are many tools available that aid to effective project management. A few are described below:

27.4.1 Gantt Chart

Gantt chart was first proposed by Henry Gantt (1917). It represents project schedule with respect to time periods. It is a horizontal bar chart with bars representing activities and time scheduled for the project activities.



There are proprietary softwares (MS-Project etc.) that help the professional project managers in effectively and successfully managing a software project.

INTEXT QUESTIONS 27.1

1. Who is ultimately responsible for the quality of project?
   a) Employee
   b) Project manager
   c) Team member
   d) Quality manager
2. Project management process groups are
   a) Planning, Controlling, Organizing
   b) Initiating, Planning, Organizing
   c) Controlling, Initiating, Monitoring
   d) Planning, Directing, Organizing, Staffing, controlling
3. State whether the following statements are true or false:
   a. Healthcare industry also requires good project management skill people.
   b. A good project manager is a good leader only.
   c. "What is to be done" is a part of planning.
   d. Project management is the process of organizing a work to achieve a specific goal.

TERMINAL EXERCISE

1. What are the skills required for being successful project manager?
2. Difference between project objective and project scope.
3. What are the different process areas in project management?
4. Describe configuration management.
5. Explain project communication management.
6. Write a short note on resource management.

ANSWERS TO INTEXT QUESTIONS

27.1

1. b. Project manager

2. b. Initiating, planning, organizing.

3. a. True

   b. False

   c. True

   d. True

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28

ENTREPRENEURSHIP SKILLS

In the previous lesson you have learnt about project management skills. Now you will learn about entrepreneurship skills. An individual who, rather than working as an employee, runs a small business and takes the responsibility of all the risk and reward of a given business venture, idea, or service offered for sale is generally known as entrepreneur. The entrepreneur is commonly seen as a business leader and innovator of new ideas and business processes.

An entrepreneur requires some natural skills for getting success in business e.g., calculated risk-taking, effective communication, management skill, quick learning ability, and self-reflection. In this lesson you will learn about what an entrepreneur is what skills are required for being an entrepreneur and so on.

OBJECTIVES

After reading this lesson, you will be able to:

- identify a person as an entrepreneur;
- define skills required for being an entrepreneur;
- explain the importance of entrepreneurship skills

28.1 WHAT IS ENTREPRENEURSHIP?

Before we start to learn about entrepreneurship skills, first let us learn about who is an entrepreneur and what is entrepreneurship.

Entreperneur is a french word meaning, "one who undertakes an endeavour". A person who starts his own business or organization is called entrepreneur. If you want to become an entrepreneur you should organize and manage your venture with considerable initiative and risk so that you can get profit from your organization. For example, if you are living in a village and you have started your shop there to facilitate your fellow villagers and for getting some profit then you are an entrepreneur.

When you start a business you have some vision for your business and you establish it according to that vision. The process of starting own business is called **entrepreneurship**. This process is characterized by risk management and innovation and it involves a good amount of investment in terms of time, money, infrastructure and relationships.

Entrepreneurs assemble resources including innovations, finance and business acumen in an effort to transform innovations into economic goods.

Each era has made entrepreneurs in its age. There are some basics to establish a business. Basics of enterpreneurship are as followes:

- Calculated Risk-taking
- Management skills
- Effective Communication
- Vision
- Connection with efficient people
- Strategy
- Marketing

Calculated Risk-taking: An entrepreneur must have courage to take risk with vision. You should have self-confidence about what you are going to do and how you are going to work. You should also be aware of the fact that success and failures may not come equally.

Resource Management skills: An entrepreneur should be able to manage time, money, infrastructure and people who are working within the organization. Efficient use of time and people establishes a successful organization.

Effective Communication: You must communicate in such a way so that customer as well as employee can understand your objective easily. Communication is not language specific, it is a way of presentation so that other person can understand your points correctly.

Vision: Lack of planning infrastructure and money leads to failure of business. Therefore an individual must have clear vision of what is to be done and how to execute his plan.

Connect with efficient people: A business always requires efficient resources. Each employee of an organization should own and take responsibility of work whenever needed. An entrepreneur must allocate right work to the right person. An entrepreneur must also have a quality to identify efficient and suitable people for a particular job.

Strategy: You should have a clear master plan for your business. At any point of time if plan A fails there should also be plan B to fall back to.

Marketing: An entrepreneur studies market needs and takes action according to that. After analysing market situation you can get some idea for your product and launching of it as per market needs. There are many ways to look for an idea. One should read a lot, talk to people and consider the questions as: What limitation exists in current market products and services? What would you like to have that is not available? What are other uses for new technology?

28.1.1 Entrepreneurship Skills

The importance of entrepreneurship has been a prominent concept discussed throughout many Youth Employment Conventions. Enterpreneural skills should be integrated in the education system as it helps the young students to engage themselves in the economic development of the country.

To gain insight into this idea we need to understand why entrepreneurship is important in the first place. Entrepreneurship is a key driver of our economy as a high majority of jobs are created by and through what started as a small idea. By integrating entrepreneurship in the education system, young people can build the confidence to see value in their own ideas. They can then make enterprising choices that are transferable into the workplace. Technical skills, managerial skills and entrepreneurial skills are needed for entrepreneurship.

Skills needed for Entrepreneurship

- Soft Skills
- Managerial Skills
- Entrepreneurial Skills

Let us discuss about these skills in details

(1) Soft skills

Soft Skills include the following:

- Communication
- Interpersonal relations
- Environmental Observation
- Coordination
- Specific operation Technology

Communication

It is a process of exchanging information among people. It needs effective language, presentation skill, environment etc. The figure below explains how to communicate effectively.

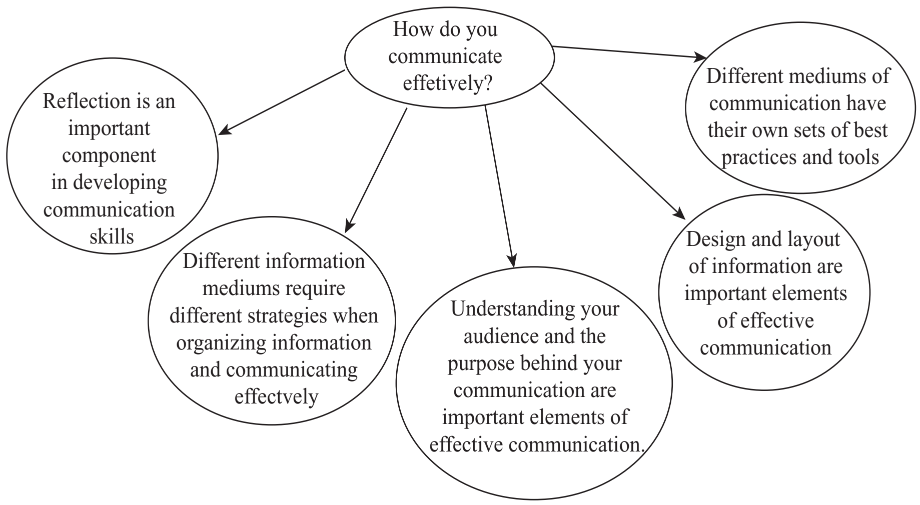

Fig. 28.1: Communication

In the next lesson you will learn about professional communication skills.

Interpersonal relations

It is a skill to communicate with each other. It is used not only in offices but in our day to day social life. People with good interpersonal skills are perceived as confident, calm and charismatic.

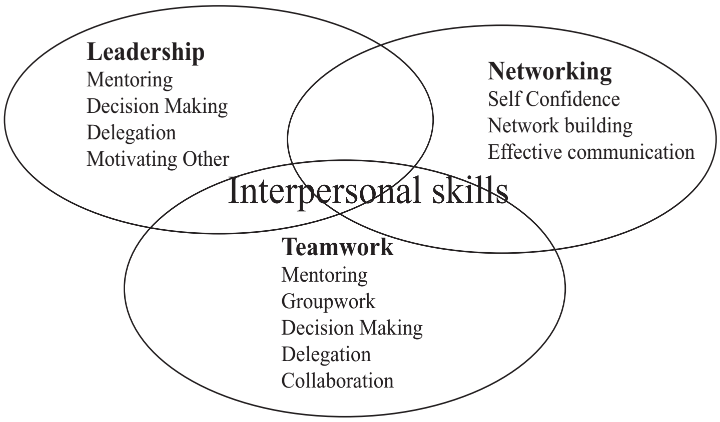

Fig. 28.2: Interpersonal skills

Environmental Observation

Environmental observation is one of the technical skills. This skill helps in understanding job objective and current scenario of the society with respect to the business that one wants to start.

Coordination

It is a skill that helps in understanding other people and work together to achieve the set goal. Coordination must exist among the team members in order to achieve best possible results.

Specific operation Technology

Sometimes specific technology is required for achieving specific goal. For example if you want to develop a software for web designing then you require knowledge of some specific technology like HTML, CSS, JAVA SCRIPT etc.

(2) Managerial skills

Managerial Skills include the following:

- Planning
- Motivation
- Marketing
- Accounting
- Negotiating

Planning

It is a basic management method involving formulation of one or more detailed plan to achieve the best result. The planning process is to identify goal, formulate strategy and decide the process to be followed to achieve the goal on the same strategy.

Motivation

Motivation is defined as goal oriented behaviour. It is frequently used to describe why a person is interested in doing a particular work.

Following points help us to stay motivated:

- Surround yourself with positivity
- Create a vision board

- Make smart goals
- Reward yourself
- Believe in yourself
- Acknowledge your positive attributes
- Recognize your progress
- Visualize accomplishing your goals
- Be kind to yourself
- Don't compare yourself to others

Marketing

It is an ability through which you sell something or create awareness about something e.g. any product. For example T.V. commercials are a part of marketing. It tries to satisfy needs of clients. It includes the coordination of product, price, place and promotional strategy. These are known as 4 P's of marketing. You have to follow the points mentioned below to ensure maximum sale of your product/service:

- Identify the product
- Determine its price
- Reach the customer
- Implement the of promotional strategy

Accounting

It is a process of keeping financial record or preparing financial record. It includes analysis, verification and reporting of records.

Negotiating

It is a process through which people settle all the problems which occur between two or more parties. Parties try to reach at mutual beneficial outcome through negotiation. Process of negotiation includes following stages:

- Preparation
- Discussion
- Goal clarification
- Arriving at mutual beneficial points

- Agreement
- Implementation of strategy

(3) Entrepreneurial skills

It includes the following:

- Innovation
- Persistency
- Visionary
- Flexibility

Innovation and Risk Taking Ability

It is a process of translating new ideas into services that create value. An idea must be replicable at economical cost and satisfy customer's need. Innovation is synonymous with risk taking. An organization that creates new idea, takes great risk of implementing a new market.

Persistency

In this skill, you continue to do something even though it is difficult or even if other people are against it. This skill requires lot of patience and determination.

Visionary

Someone who can visualize the future and take action according to that is visionary. A visionary has clear ideas about what should happen and what strategy can be formed to achieve best possible results.

Flexibility

Flexibility is willingness to change as per the changing environment, for betterment. One should not be stringent about his/her way of working; rather should be able to adapt new ways easily.

INTEXT QUESTIONS 28.1

Fill in the blanks.

1. A person who starts his business or organization is called ……….......…
2. ……….......… is a process of keeping financial record or preparing financial record.

3. ……….......… is a process of translating new ideas to services that create value.
4. ……….......… is a process of exchanging information among people.
5. The process of starting own business is called……….......…

WHAT YOU HAVE LEARNT

- A person who starts his/her own business is called an entrepreneur.
- A process of starting own business is called as entrepreneurship.
- Communication is a process of exchanging information among people.
- Technical skills include communication, interpersonal relation, environmental observation, coordination and specific operation technology skills.
- Managerial skills include planning, motivation, marketing, accounting and negotiating skills.
- Entrepreneurial skills include innovation, persistancy, visionary, change orientation and risk seeking skills.
- A good entrepreneur needs technical skills, managerial skills and entrepreneurial skills.

TERMINAL EXERCISE

1. Differentiate between entrepreneurship and entrepreneur.
2. What are the qualities of a manager?
3. What are the types of soft skills required by an entrepreneur?
4. Why risk-taking ability is needed for entrepreneurship?
5. What is the meaning of efficient people in entrepreneurship?

ANSWERS TO INTEXT QUESTIONS

28.1

1. entrepreneur	2. accounting	3. innovation
4. communication	5. entrepreneurship	

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PROFESSIONAL COMMUNICATION SKILLS

In the previous lesson you have learnt about entrepreneurship skills. You have already learnt that communication skill is also an important skill needed to be an entrepreneur. Communication happens when two or more people interact and share their thoughts, feelings, viewpoints and messages. It is a process where human beings elaborate their social skills by transmitting and receiving information with one another. In professional setup it is very important to develop some guidelines and best practices for appropriate communication between different stakeholders or clients. If a common goal or an objective has not been set up, it becomes very complex to achieve it unless people openly share thoughts, ideas and information within a communication skill framework. This lesson has been specifically designed to provide some guidelines and best practices to improve the communication skills within an organization.

OBJECTIVES

After reading this lesson, you will be able to:

- build awareness about various types of interpersonal communication in professional setups;
- develop effective communication skills;
- discuss assertion skill, listening skill and conflict resolution skills in office environments;
- improve communication skills;
- make requests and give directions in professional environment.

29.1 COMMUNICATION SKILLS

Throughout the professional life one faces complex and sometimes tough engaging situations with superiors, subordinates, and peers. Communicating with various stakeholders is very crucial in all organizations. In addition to other forms of communication activities such as writing a letter or preparing a formal presentation, interpersonal communication is a day-in day-out activity which we all engage in everyday life.

Interpersonal communication is unavoidable and can not be escaped; abilities in this domain are of extreme importance in professional organizations. Communication skills have always ranked among the topmost skills desired by prospective employers. They are of crucial importance within the organization and many a times people have been separated from the job because of poor interpersonal communication skills.

Communication skills are an important aspect of interpersonal skills. It encompasses verbal as well as non-verbal cues and interactions in one-on-one or among members of a small group. People with good interpersonal skills can easily relate to and work with diverse set of people within the organization. They can easily negotiate the differences, disputes and can handle conflicts. They can make required requests easily, receive information and work effectively and efficiently. Generally a person with good communication skills will be open to wide variety of ideas and is always willing to put forth his or her viewpoint in order to solve problems in the organization.

Skills that are critical for effective communication are:

- ***Assertion skills.*** These include verbal and non-verbal behavior and enable us to maintain respect, satisfy our needs, and defend our rights without dominating, manipulating, abusing, or controlling others.
- ***Listening skills.*** These skills enable us to understand other people's point of view. These include new ways of responding so that the other person feels that his/her point of view has been appreciated and respected.
- ***Conflict-resolution skills.*** Conflict resolution skills are very important in organization setups. These skills are critical because conflicts do happen in organizations on a regular basis and these skills are very helpful in effective resolution of such conflicts.

Let us learn these skills in detail.

Notes

29.1.1 Assertion Skills

The communication skill of assertion is related to high self-esteem, confidence and an acceptance of yourself and your abilities. Assertive communication skill emphasizes the rights of the individual as well as the rights of the other people. In specific situations and when there is a need, an assertive person can disagree, stand up for his/her own rights and present alternative points of view. He or she does this without being fearful but at the same time without being intimidating or putting the other person down. In contrast, a person who feels threatened in such situations behaves with aggressive or non-assertive responses. He/she will either start shouting or will intimidate other person or will just be cowed down and not speak anything.

The aggressive or non-assertive behavior comes from feelings of low self-esteem or low self confidence in one's abilities. Unfamiliar domains, lack of knowledge in the subject or general personality trait makes one feel threatened. So in situations of disagreements, the person behaves either with aggression and anger or just becomes too submissive and passive about the ongoing activities. An aggressive person tries to dominate and humiliate others just to prove the point that a better solution is not acceptable as it is not what he or she suggested. On the other hand, the subdued person will simply not assert himself or herself and will follow the orders even if he or she personally feel bad about it. When unpleasant situations arise, a submissive person tends to avoid these.

So contrary to popular perception, in communication skills, assertiveness is not a way to force your point of view. Instead, it only means that you are in control of your own decisions and behaviors. The assertive style also involves respecting the same control of feelings for people in front of you and gives space to counter view-points irrespective of whether one agrees to those viewpoints or not. Persons with good assertive communication skills easily handle co-workers without being aggressive by recognizing the rights of colleagues and co-workers. They do not try to manipulate the things and understand the right of others to have their own viewpoints. An assertive person is comfortable in negotiations and does compromise wherever required without feeling let down or uncomfortable.

Assertive communication skill shows expressions, inner feelings and openness about yourself and your co-workers. Let's look at some common workplace examples wherein the communicator is quite aggressive:

> *"You have prepared a poor report. Go and work again."*

Notes

"You are so stupid, can't handle this simple task. It is end of week and delivery time is right here"

"How many times do I need to tell you the same thing? Can't you do it correctly in the first go."

Statements like above are called finger pointing "you" statements, these are directed to intimidate and put down a co-worker. On the contrary, assertive communication skills require you to be more subtle about such situations:

"I am afraid this report might not be acceptable. Please work a little bit more on this."

"I was under impression that this task is simpler. Let's make our full effort to complete this task as we have reached the delivery date."

"I am bit concerned about the mistakes being repeated more than once. Let's develop a best practice and put in our best effort to capture all the mistakes in the first go itself."

Using assertive style shows that one can easily put forward his or her point of view in a non-judgmental way and without denigrating the other person. Such style shows compassion and also lets the other person know how their performance and behavior has been perceived.

Assertive communication style involves:

- Being non-judgmental about the behavior of person one is interacting with.
- Being able to disclose one's own feeling without feeling fearful or threatened.
- Being able to convey the importance of outcomes from other person's behavior.

The fundamental principle is that one should focus on behavior description without drawing inferences about the motives, character or attitude of the person. It should be objective, brief and to the point. A concrete and observed outcome should be explicitly told to the other person outlining the negative or positive results from his or her behavior or actions.

The assertion skills play an important role in various types of interactions that happen in organizational set-ups. We will elaborate some of these interactions and how assertive communication skills play a role in each one of these.

A. Providing Feedback

Feedbacks are often sought in organization setups. Feedbacks are essential for efficient execution of various tasks and projects. Providing feedbacks is a tricky

task because many times we are unaware about how the person (to whom we are providing the feedback) will react and respond. But effective feedback mechanism is crucial for effective communication in the organization. Both providing and receiving feedback in a cordial way is important to build trust and develop relationship among employees. It creates a positive atmosphere within the group, encourages communication and gels the unit together. A group where feedbacks are not encouraged is devoid of ideas and becomes obsolete in the long run.

During communication wherein feedback is being given or received, one should be open to ideas, should show interest in the other person by both verbal and non-verbal signs. One should encourage open flow of ideas and must try to understand the point of view of other person. It is a good idea to interject the person providing the feedback with statements which emphasize the feedback of other person like: *What I understand you are pointing out is….*Or *Please tell me more about this particular aspect….*etc.

While providing feedback, be specific as far as possible. Also try to gauge an appropriate time to provide feedback. Suggestions and feedback are more likely to be accepted if the other person is not in a defensive framework of mind. Be careful to provide feedback which is within the capabilities of the receiver and can be handled by him or her. One should always avoid bringing up past occurrences of negative behavior. Also always be open to receive the response after you have provided the feedback. Try to acknowledge the response; many times it can point to something wherein the change needs to be made by the person providing the feedback.

Feedback communication within an organization can be of the following types:

- Negative in nature
- Positive feedback from managers or seniors
- Positive feedback from colleagues
- Self-appraisal

In general, negative feedback is not always harmful. It can lead to positive efficient changes in the receiver if it has been delivered in an appropriate way. Positive feedback mostly encourages positive role and contribution from employees and motivates them to perform better. Self-appraisal is also a form of feedback wherein the person evaluates his or her performance and discusses it with colleagues or seniors.

So a good feedback mechanism within an organization improves the performance of employees, develops trust and bonhomie among the stakeholders. In an organization, most of such communication happens in front of each other. So it is an important skill which employees should strive hard for. Also it is important to match your body language and actions with the assertive feedback communication style.

B. Constructive Criticism

In our day-to-day life, we all come across criticism in one form or the other. We criticize others at times and on other occasions we get criticized by others. It is an important communication skill to impart constructive criticism. Equally important is to accept criticism without being too defensive or aggressive. Some of the suggestions and acceptable ways in a conversation involving criticism are as follows:

- Ensure that you are the authorized person or stakeholder to critique the person or the work. If you are not, there will be resentment.
- Try to convey one complaint at a time. Too many complaints, too much criticism at once is counterproductive.
- Always check the facts before jumping the gun. False complaint leads to arguments and distracts the conversation and fails to achieve the desired goal.
- Always make sure that criticism happens face-to-face and in private. Even well intentioned criticism is received with a bit of embarrassment. Make sure that the receiver does not feel too harassed, intimidated or dejected by using encouraging verbal and nonverbal signs. Constructive criticism is meant to improve the outcomes and should always be done objectively without any prejudices.
- Constructive criticism should be clear and specific and must put forth the improvement aspect so that the receiver does not feel offended.
- Always ensure that if a particular aspect has been criticized, the overall perception and appraisal of the person does not get affected because of such things.
- Wherever possible accept the partial responsibility for the issue or problem. Statements like *"Probably I failed to give clear instructions in the beginning…"*etc., will help balance the discussion.
- Make sure that accusatory verbal and non-verbal signals are not projected during such meeting. Avoid finger pointing gestures, rude language or high pitched tone. Converse normally and put forth the criticism in a decent manner.

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In the end it is important that the receiver is given sufficient time to put forth his/her point of view and to respond appropriately if he or she finds some criticism objectionable. This always has emotionally soothing result. Ensure that some quiet moments are tolerated and once the receiver speaks, he or she is heard patiently and compassionately.

C. Requests and Directions

Requests and providing directions to colleagues, superiors or juniors is part of everyday activity in an organizational setup. Every new employee must learn this form of communication skill. It is very useful as a new employee needs to make requests to varied people within the organization to understand the setup, to comprehend his or her role in the organization to collaborate and coordinate with different departments like HR, Finance, his or her own team, training coordinator etc. Everyone has lots of questions when he or she joins an organization. This is required to learn the things on the job and to find his/her way around. Settling into a new role takes a physical and mental toll and it is easy if one has right set of communication skills. It makes the task much more easy.

Many a times, due to our inherent nature, we are reluctant to ask for information. Sometimes we feel that asking such questions might make us appear a bit silly. We sometimes feel helpless. But if the request for information has been done in a proper and pleasing way, it will lead to getting the required information and projecting a good positive image about your enthusiasm and mannerism. You will be able to make new friends and will be able to enjoy the workplace like you enjoy the company of your friends.

So what are the qualities of good assertive communication skills for making requests? Make sure that your query is specific and appropriate. Ensure that you are asking for information to the right person. In case of doubts, always ask first like *"can you please let me know the way to the finance department"*. Once there, you can ask your queries like *"please let me know where to assign my tax saving investments on the HR tool?"* etc. Note that after making the initial honest effort on your own, it is always good for an employee to ask for help from others. In general, people will be ready to help and cooperate if the sought after help is in their purview and the request has come in a polite manner.

Similarly giving directions and directives to other teams, your team members, other stakeholders or even to colleagues or superiors is sometimes necessary and required by the work flow demands of the job. So, both these communication skills of requesting and giving directions are crucial for organizational strategies and to achieve the set goals. The table 29.1 shows some of the requests and directives. The difference can be seen.

Table 29.1: Difference between request and directive

Requests	Directives
"Please let me know the way to the finance department?"	"Ensure that you communicate this data to the finance department."
"Can we meet in the afternoon?"	"See me in my room at 3.30."
"Where shall I submit this expenditure claim form?"	"Give this form to HR team"
"Is there any way we can finish this committed task today?"	"I am expecting the project completion report today."

Making requests create a supportive positive environment and gives people a sense of control in carrying out their tasks and responsibilities. Those who carry out requests are likely to have a better attitude and to perform their duties in a more effective manner than those who are expected to obey directives. But, in situations that call for specific action, directives may be more appropriate than requests (for instance, when there is danger).

It is possible to give directives in a positive way that does not assume a power imbalance. You can do this by explaining the reason for the directive. Do not simply make a demand without telling co-workers why they should do what you say. Indeed, if you give a directive, you should have an important reason for doing so and be willing to explain it to others. They are much more likely to cooperate when they see the need for such action. The directives in the table above can be rephrased like this:

Table 29.2: Directives (rephrased)

Original Version	Rephrased Version
"Ensure that you communicate this data to the finance department."	"Be sure you get in touch with the finance department with this data. They are expecting this data for monthly revenue number generation."
"See me in my room at 3.30."	"See me at 3.30. We need to discuss the details and status of ongoing projects.
"Give this form to HR team"	"Give the form to HR team. I am stuck in a meeting and have a short break now."
"I am expecting the project completion report today."	"I need the report today because it is important that we stay on schedule."

Although we have suggested, in the preceeding sections, various techniques for improved communication with others, ultimately there is no magic wand to

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improve it. Sometimes what works in one scenario might not work in other. Most of these interactions happen face-to-face with human beings and not with robots. There are personal choices, quirkiness, egos, sensibilities etc. In general the guidelines provided here will be fruitful but one needs to adapt it to different situations so that work is carried out efficiently and effectively. Awareness of the scenario and the environment is critical. We need to be calm, polite, respectful to others but positively assertive in our communication style.

29.1.2 Listening Skills

Given that we have been listening right from our birth, it might seem that we are good at it. The truth is many studies have revealed that the majority of us are not good listeners. We retain only 25-50% of information just after we get involved in a conversation with others. We all encounter situations wherein we are talking and we can sense that the person to whom we are talking to is lost in his/her own thoughts and is not paying any attention to what we are saying. Same is the case with body language which gives out clear signal if we are really interested in or listening in to the other person.

Some key aspects of good listening skill are:

- **Pay Attention:** Try to give full attention to the speaker especially in situations where you are engaged in one-to-one face-to-face conversation. Try to have regular eye contact with the speaker. Put aside your roaming thoughts. Avoid being mentally challenging the thoughts of the speaker. Also look out for and encourage positive body language signs from the speaker.
- **Appropriate Body Language:** Use facial expressions, smile, and nod occasionally. Try to adopt an open and inviting posture and encourage the speaker with occasional interjections and words like, *right, huh, correct, yeah, yes.*
- **Provide Feedback:** Many times, our prejudices, judgements, background and beliefs cause us to filter the information while we are listening to others. So it is important that we are aware of this trap. A good way to avoid this is to reflect and re-phrase the points being made by the speaker using statements like *Seems like what you are saying is* or *I am having the understanding that* etc. It will have the desired effect that the speaker would feel positive about you. It will also show that you are an active listener which is always considered good mannerism.
- **Be Responsive:** Be respectful and understanding. Any official discussion at work place is basically sharing of information and ideas. It always makes you richer in terms of knowledge and ideas gained. Try to be open and honest in your responses in a respectful way. Treat the other person in the same manner you would like others to treat you.

- **Receiving Criticism:** Receiving criticism is one of the toughest communication skills to master. Generally, in the face of criticism, people respond with either becoming aggressive or becoming too defensive. The main idea in such situations is to analyze the criticism. Understand the facts, perceptions or other factors behind such criticism. If you know that mistakes are being committed for which you are directly or indirectly responsible, it is always a good idea to avoid the argument on truthfulness. Accept the lack of attention to detail and focus on finding the solution for the problem at hand. It does not mean that you are agreeing with every criticism being thrown at you. It simply means that correcting the mistake and finding solution is far more important than quibbling about who did what.

In case you do not agree with the criticism and you are sure that criticism is unjustifiable, ask for specific examples like *Can you please describe with example what should I have done differently?* etc. Try to re-phrase the criticism and shift the focus on outcomes, areas of improvements, suggestions and feedback.

29.1.3 Conflict Resolution Skills

Conflicts at workplaces are common occurrences. A workplace without conflicts among employees is a bland, boring and not a dynamic workplace. Conflict can arise between two co-workers, between you and your superior, between two departments, between customer or client and yourself, between organizations and between you and your subordinate. Differences in working styles, personality traits, viewpoints on goals and expectations, values, beliefs, facts vs projections can all lead to conflicts. When you encounter conflicts at workplace, you normally act as one of the following:

- **Compromise:** You can try to compromise if there are really some grounds where you see a possibility of convergence. It is a good strategy in such circumstances.
- **Collaborate:** Normally, when you are in the organization for long, you understand the work culture as well as the nature beliefs of your colleagues and you also have idea of overall functioning of different departments. In such cases, collaboration is the best strategy in times of conflicts.
- **Overrule:** Use this strategy rarely and in situations where the issue at hand is far more important than personal relationships. Here you enforce your idea based on gravity of the situation.

Conflicts can be good for the work place or they might severely impede the workflow and deteriorate the environment within the group. In a healthy environment, conflicts lead to creativity, critical thinking and gets people on their

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toes to improve and perform at their best. On the other hand when conflicts slip out of hand, they lead to rumors, sabotages, lower the morale and polarize people around conflicting opinions. To resolve the conflicts, some of the best practices are listed below:

- **Be Prompt:** Resolve the problem and issues at the earliest, delays always escalate the issues into major conflicts. If emotional outbursts are involved, ensure that a bit of cool off time is given to both the parties involved.
- **Meet Face-to-Face:** If possible, meet each other face-to-face over a cup of coffee on a neutral location and see if some kind of compromise formula can be achieved.
- **Listen Empathetically:** It is never easy to calm your nerves in conflict situations. Still try to be calm, listen actively, and try to send positive signals via body language. In conflict situations, each party believes the correctness of their version. Always try to demarcate the happenings from feelings.
- **Be Problem Focused:** Do not be person focused, do not be judgmental about the personality, beliefs of other person. It is always a good idea to focus on the issue.
- **Brainstorm:** Negotiate, brainstorm, and arrive at solutions. Create something wherein both parties feel vindicated and winners.
- **Formalize and Implement:** Put the negotiating terms, solutions, way ahead etc., on paper and follow up regularly and amicably in an accountable manner.

Being the first mover in resolving the conflicts at a workplace is not a sign of weakness. On the contrary, it is normally appreciated by all the stakeholders and colleagues as a sign of good personality trait. Before going forward with rapprochement, analyze your role in an objective way. Try to remain calm and make sure that emotions are in check. Always put team goals above personal ego battles and goals.

While meeting the other person, listen to his side of story first. Re-phrase some of that so that your understanding enhances and the other person feels comfortable. As mentioned above, ask for specific examples. Do not get angry or argue too much. Do not be condescending or demeaning while dealing with other person. Look out for areas of compromise and agreement. If the situation has already become way too complex, try to schedule another round of meetings. This will give more time to understand, appreciate and find solutions for the conflict under consideration.

INTEXT QUESTIONS 29.2

I. Choose the appropriate answer:

1. Exchange of ideas between two entities is __________ .
   - a. Understanding b. Telling
   - c. Communication d. Listening
2. Communication involves __________ .
   - a. Speaking b. Listening
   - c. Understanding d. All of the Above
3. In absence of any receiver, there is no __________ .
   - a. Communication b. Sender
   - c. Message d. Media
4. Which of the following is an example of a nonverbal message?
   - a. Eye Contact b. Yelling
   - c. Mumbling d. Crying

II. State whether the following statements are true or false:

1. Non-verbal cues like eye contact are not a part of communication skills.
2. Conflict never happens at workplace as they are hierarchical in nature.
3. Being a good listener is an important part of good communication skill.
4. Assertive communication skill means being aggressive in your communication.
5. Conflict resolution should be done as soon as possible.
6. Re-phrasing or paraphrasing is considered good communication skill.

WHAT YOU HAVE LEARNT

- Communication skills are an essential aspect of interpersonal skills.
- Assertion skills include verbal and non-verbal behaviour and enable us to maintain respect, satisfy our needs and defend our rights without dominating, manipulating or controlling others.
- Listening skills enable you to understand other people's point of view.
- Conflict resolution skills are important in an organization setup.

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TERMINAL EXERCISE

1. What is re-phrasing or paraphrasing?
2. Give some examples of directives delivered in assertive positive way.
3. Are communication skills important at workplace? Why?
4. What kind of body language should be used in professional communication?
5. What are the three critical skills required for effective communication?
6. Describe how best conflict situations are resolved at a workplace.
7. How will you provide constructive criticism to your subordinate who has not been able to complete the given task on time?
8. What are good listening skills?

ANSWER TO INTEXT QUESTIONS

29.1

I.	1.	a	2.	d	3.	a	4.	a
II.	1.	False	2.	False	3.	True	4.	False
	5.	True	6.	False				